

June 1997

Mobile Radio Technology[®]

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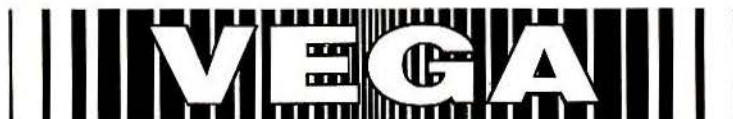
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Dispatch services compete with wireless telephone for available frequencies



Hawaiian Wireless, based in Honolulu, began using specialized mobile radio (SMR) frequencies to provide cellular telephone service on Feb. 6, 1997. Unlike the combination of dispatch, telephone and paging services provided by Nextel Communications, McLean, VA, Hawaiian Wireless does not offer dispatch service. Let's say that again. Hawaiian Wireless, an SMR system operator, does not offer dispatch service. Why is that important?

SMR originally was envisioned as a means to extend dispatch services to more organizations. Entrepreneurs would build 800MHz repeater systems to rebroadcast, usually over a wide area, signals picked up from portable and mobile two-way radios. Many organizations with requirements for mobile communications among their workers then could be served by renting airtime on the SMR system instead of building their own repeaters or networks of repeaters.

SMR operators tend to build systems where population is concentrated, and some organizations must send workers where few people go. For that and other reasons, some organizations prefer to control their own radio communications systems.

Here are the definitions:

An entrepreneur builds a radio communications network and sells airtime to others = SMR.

A business or public safety agency uses its own radio communications network = private wireless (formerly "private radio").

Communication over a radio network (SMR, private wireless) among members of one organization = dispatch.

Making phone calls on a radio network (cellular, PCS, SMR) = wireless telephone.

From at least two perspectives, the ac-

complishment of Hawaiian Wireless can be admired. In marketing, it has allowed the entry into Hawaii of a fifth wireless telephone carrier, along with cellular carriers BellSouth and GTE, and personal communications service (PCS) carriers Western Wireless and PrimeCo. In technology, it represents a conversion of cellular infrastructure and handsets to work on the 850MHz SMR band.

The problem is that Hawaiian Wireless' accomplishment represents a diversion of radio spectrum from dispatch service to telephone service. At one time, the federal government discouraged the use of radio networks built for dispatch from being used for wireless telephone. Not anymore, and not since many years ago.

Legal and technical considerations make it difficult to auction dispatch frequencies. Wireless telephone frequencies, well, that's a different matter. The fact that most wireless telephone frequencies can be sold is enough for many federal lawmakers and regulators to close their minds to the need for dispatch service.

Dispatch service serves an important role in safety and commercial productivity. Companies that supply fuel, baggage and security services at airports use private wireless. Mining, farming and manufacturing companies use private wireless. Police, fire and emergency medical agencies use private wireless. Utility, petroleum distribution and electrical transmission companies use private wireless.

Aside from improving the safety of workers, customers and the public, private wireless systems improve business efficiency. They conserve resources, reduce costs and prices, and strengthen the competitiveness of American industry vs. foreign producers.

The lure of converting SMR frequencies away from dispatch service has proved to be powerful. In some cases, it has yet to become profitable. Sometimes it seems as though every mobile communications application has to be consumer-oriented, such as wireless telephones, pagers and laptop computers.

The value of private wireless seems so clear to people involved with it that sometimes they have trouble understanding why it doesn't seem clear to so many lawmakers and federal officials. It may be difficult to overcome the money argument that wireless telephone means auctions, and private wireless does not. Even so, the case can be made that loss of dispatch service means the loss of jobs, the loss of business to foreign competitors and, in some cases,

increased safety risks.

Private wireless users, on their own and with the encouragement of trade associations, visit the FCC and Capitol Hill to explain their communications requirements. Some equipment dealers and SMR operators make individual visits, too, and many of them work through trade associations in an effort to retain and expand dispatch frequencies. The effort has to continue.

A lot of advice about how to influence government decisions gets handed out at industry conferences. Here are some examples:

□ An FCC official says that, as important as dispatch service may seem to be, companies that use it and companies that provide it compete for attention with many other voices. Respond to commission notices of inquiry and rulemaking proceedings, write to commissioners and policymakers, and telephone and visit the commission, he advises. And don't stop.

□ A trade association executive says that although it is all right to "go over the commission's head" by directing efforts at federal lawmakers, it is better to begin with the commission. If the results are not what you want, write to the people at the commission to whom you made your case and let them know you respect their opinion, but you are going to take it further. "Don't burn bridges at the commission," is his advice.

□ A telecommunications attorney says that it is important not only to act on your own behalf, but to act as part of a trade association that best represents your interests. Some associations tend to represent large or small businesses better. Choosing an association based in part on the size of your business may improve the results of the time and money you spend.

Once upon a time, the future looked rosy for dispatch service. First 800MHz, and then 900MHz frequencies were allocated for the purpose, after having been retrieved from TV broadcasting. Today, many of those frequencies seem headed for wireless telephone service.

More recently, the FCC proposed to retrieve 10 more TV broadcasting channels and make them available in part for wireless communications. Maybe only public safety agencies are assured of receiving some of those frequencies for private wireless. It will take a great deal of effort to bring some of those frequencies over to private wireless for business and industrial use. It will be worth it.

—Don Bishop

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- ☐ The R-2680 with optional MPT 1327 (AH)
- ☐ The Micro RF Isolator (AF)
- ☐ All of the above (AZ)

2. What do you usually test?

- ☐ Two-way radios (JA) ☐ Pagers (JE)
- ☐ Trunked radios (JF) ☐ Cell sites (JT)
- ☐ Encrypted systems (JG) ☐ Cell phones (JU)

3. When do you plan to buy test equipment?

- ☐ In 1 month (HA) ☐ 7-12 months (HC)
- ☐ 2-6 months (HB) ☐ More than a year (HD)

4. Do you buy test equipment in your company or does someone else?

- ☐ I do (EA)
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- 2-5—**Supercomm**, sponsored by USTA and TIA, New Orleans Convention Center, New Orleans. Contact: 202-326-7300.
- 3-5—**Canadian Wireless**, sponsored by the Canadian Wireless Telecommunications Association, Montreal. Contact: 613-233-4888.
- 8-12—**IEEE International Conference on Communications**, sponsored by Alcatel, BCE Mobile Rogers Cantel, Bell Canada, Bell Canada International, BellCore, Harris Farinon Canada, Lucent Technologies, Motorola, Nortel Technology, Stentor, Teleglobe Canada and VISTAR; Palais des Congr s, Montreal. Contact: 905-615-6507.
- 9-11—**Communications Expo/Show of the Americas**, Miami Convention Center, Miami. Contact: Jackie Gonzales, 305-412-9000.
- 22-26—**UTC National Conference & Exhibition**, sponsored by UTC, The Telecommunications Association, Oregon Convention Center, Portland, OR. Contact: 202-872-0030.

August

- 10-14—**International Association of Public-Safety Communications Officials (APCO) National Conference**, Charlotte, NC. Contact: 904-322-2500.

September

- 10-12—**Personal Communications Showcase**, sponsored by the Personal Communications Industry Association, Dallas Convention Center, Dallas. Contact: 800-326-8638.

October

- 27-29—**Wireless Apps**, sponsored by the Cellular Telecommunications Industry Association, Seattle Convention Center, Seattle. Contact: Francesca Dea, 702-739-4025, or Tim Ayers, 202-736-3203.

November

- 6-7—**AMTEX**, sponsored by the American Mobile Telecommunications Association, Hilton at Walt Disney World Village, Orlando, FL. Contact: 202-331-7773.
- 6-8—**Second International Congress on Commercial Trunked Radio**, sponsored by the International Mobile Telecommunications Association, Hilton at Walt Disney World Village, Orlando, FL. Contact: 202-331-7773.
- 12-16—**Communications Marketing Conference**, sponsored by the Communications Marketing Association, Holiday Inn International Drive Resort, Orlando, FL. Contact: Bernie Brownson, 303-371-8182.
- 21—**Radio Club of America**, Communications Symposium, 88th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Gerri Hopkins, 908-842-5070.

1998

February

- 23-25—**Wireless**, sponsored by the Cellular Telecommunications Industry Association, Georgia World Congress Center, Atlanta. Contact: 212-964-7000.

April

- 22-24—**International Wireless Communications Expo**, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. Contact: 800-288-8606.



Mobile Radio Technology

Technical information for paging, SMR and private wireless networks

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Good radio/bad radio comparison tests

By Harold Kinley, C.E.T.

One of the best resources for troubleshooting a defective radio is the good radio/bad radio testing technique. Having a reference radio that is known to be operating properly can be an extremely valuable reference tool when troubleshooting a defective set.

Two live-sets

When troubleshooting a defective set

and comparing measurements from the bad set to the good set, it is inconvenient to constantly transfer the power hookup and RF connector cable from one set to the other. A simple way around this is to power up both radios simultaneously, as shown in Figure 1, top left. Also, for receiver testing, a signal combiner (hybrid or simple resistive type) can be used to connect the signal generator to both receiver inputs. Actually, a simple "tee" connector could be used to connect both receivers to a single signal generator. A

mismatch will result, but because we are only interested in *relative* measurements, the mismatch should not cause a problem. *Both sets should be equally affected.* This eliminates all the cable swapping that can become annoying during extended testing periods. For checking comparison points in both receivers simultaneously, a dual-trace oscilloscope can be used, as shown in Figure 2, center left.

For transmitter tests requiring the transmitter to be keyed, a simple coaxial switch can be used to divert a dummy load or service monitor from one set to another, as shown in Figure 3, bottom left. The coaxial switch is much more convenient than cable swapping. An alternative is to use two dummy loads, unless you need to monitor the power output or other modulation. Then you must use two service monitors or power meters if the instruments are available.

The other problem with transmitters is having to key them. If you need two free hands for testing, it will be inconvenient to use the microphone for keying. One alternative is to use a foot switch for keying by wiring up a switch for transferring the foot switch between the good set and the bad set, as shown in Figure 4 on page 40. If two hands are not needed, the microphone can be used to key the transmitter.

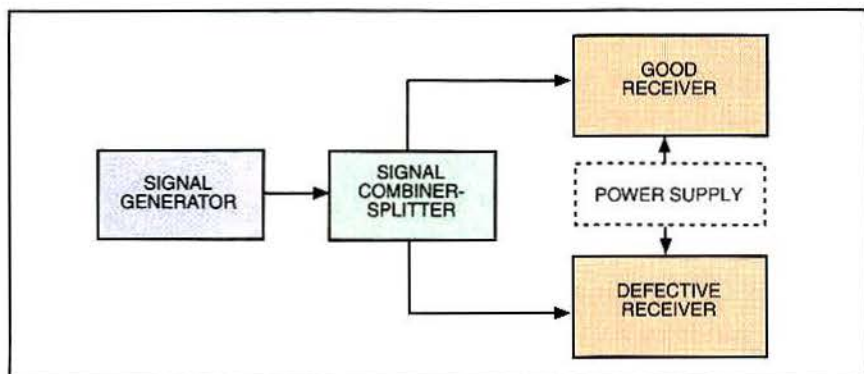


Figure 1. Two receivers can be fed from a single signal generator and operated live for comparison.

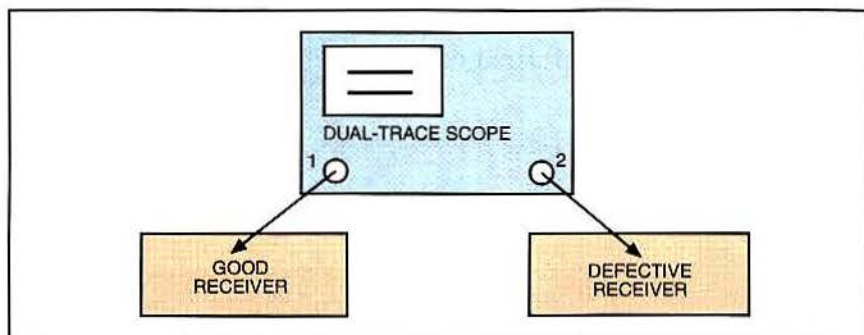


Figure 2. A dual-trace oscilloscope can be used to check comparison points in both receivers at once for easy comparison.

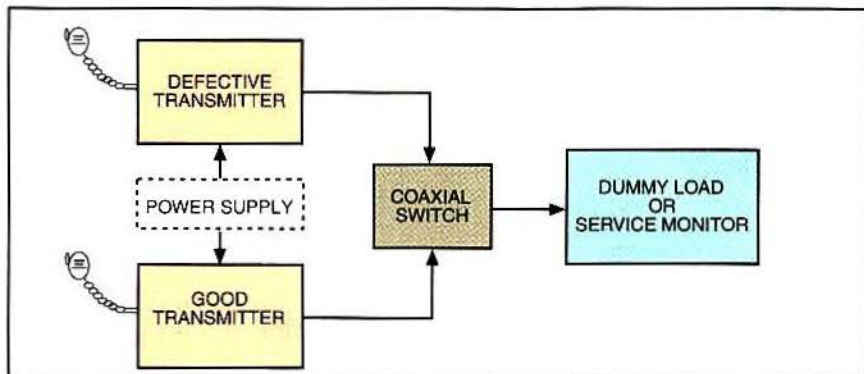


Figure 3. Two transmitters can be connected to a single dummy load or service monitor through a coaxial switch for convenience if a second dummy load or service monitor is unavailable.

Reference measurements

If the *two-live-sets* method isn't convenient, reference measurements made on a radio known to be in good operating condition can be used for future reference. The advantage of making your own reference measurements instead of using the manufacturer's reference measurements (if available) is that you are using the equipment for the reference measurements that you would use in actual troubleshooting. Thus, any loading effects of this equipment will be the same as the equipment used for the reference measurements. Basically, we are interested in the *signal* measurements and not

(continued on page 40)

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is a member of the Radio Club of America. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewyld Drive, Spartanburg, SC 29301. Kinley's email address is hkinley@aol.com.

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Utilities as SMRs: Using simulcast trunking

Replacing its VHF conventional radio system with an advanced wireless communications network allows a public utility to accommodate independent talk groups, reduce congestion and expedite customer service.

By Salvatore R. Coco, P.E.

Even in the electrical distribution business, you get unexpected "connections." In early 1993, John Berry, supervisor of radio and cable for the Kansas City, KS, Board of Public Utilities (BPU), called me about the then-proposed Part 88 addition to the FCC rules. That telephone call started the journey toward developing our new trunked radio system.

The thrust of the FCC proposals meant that an already-taxed radio system would face even more stringent operating requirements. The BPU serves about 65,000 electric customers and 57,000 water customers over a 125-square-mile metropolitan area. The BPU had already suffered from relatively heavy radio traffic on several of its assigned VHF and UHF channels. The FCC's proposed rule changes

would require all land mobile users in the VHF and UHF frequency bands to use equipment that operates on a narrower bandwidth with restricted output power. Two 50% reductions in bandwidth were proposed, so that eventually 25kHz of bandwidth would be reduced to 6kHz. [These changes, originally proposed as a new Part 88, have been incorporated into recent "refarming" decisions affecting Part 90 of the FCC rules.] To meet these requirements, all of BPU's VHF and UHF equipment would have to be replaced. Additionally, the coverage area would suffer.

With the concurrence of Anthony Pike, manager of Electric Operations at the BPU, Black and Veatch Engineering of Kansas City, MO, was commissioned to study the existing radio system, the requirements for a trunked radio system and the functional specification for a trunked radio system.

Traffic control

Moving some traffic from heavily

loaded channels to less busy channels was considered as a possible system solution. The channels available were used for semi-private conversations between supervisors. Sharing with other users would abrogate these private communications.

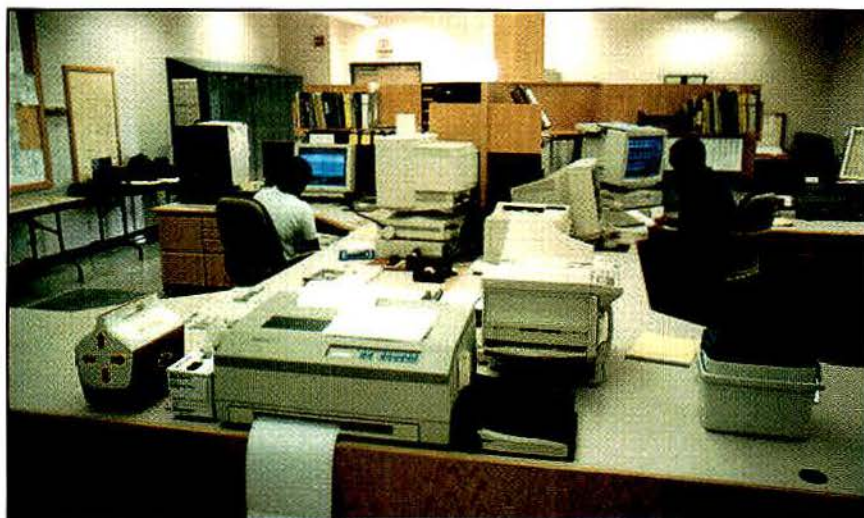
The number of available trunked radio frequencies in October 1993, the date of the Black and Veatch report, was limited. If the BPU waited until the FCC proposal was implemented, the trunking radio option might not be available. In either case, the BPU was subject to costs because of the change. The BPU opted to go forward with implementation of a trunked radio system. In hindsight, this was a fortuitous decision, as trunked radio frequencies for the utility band in the Kansas City area were no longer available after 1995.

Trunking radio takes several frequencies or channels and pools them so that maximum use can be made of the available channels. Functional elements of the business entity, in this case the BPU, are assigned talk groups. When a member of a talk group wishes to communicate, access to a non-busy channel is assigned once the transmit button on the radio is depressed. Through computer control and the control channel, all other members of the talk group are assigned to the same channel. No waiting takes place, and all the channels are more efficiently used.

Contrast this with a conventional radio system, where channels are assigned to a functional group. A conversation on one functional group channel makes it busy to other users in that group. Whereas other channels assigned to other groups may be idle, the user must wait until the functional group channel becomes free before a communication can be initiated.

The BPU system design included use of two existing sites at 11th and Steele streets and 110th and State streets, as shown in Figure 1 on page 12. These two sites are situated at the east and west extremes of the BPU service territory. A

Coco is director of electrical engineering for the Kansas City, KS, Board of Public Utilities.



Consoles for the BPU radio system were located at the BPU Energy Control Center, Waters Operations center and the Service Center.

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third site at 27th and Vernon was required for central and river industrial park coverage. A simulcast system with seven radio frequencies, one as a control channel, would provide adequate service. The central controller would be placed at the BPU Service Center, centrally located in our service territory. Consoles would be located at the BPU Energy Control Center, Waters Operations Center and the Service Center, the latter divided between

our trouble board operation and meter reading. Microwave radio would be used for communication links to the remote radio sites and remote console location (Water Operations). With a proposed budget approval in 1994, project completion was projected for mid-1996.

Design decisions

As the detail design of the system progressed, the BPU was challenged with a

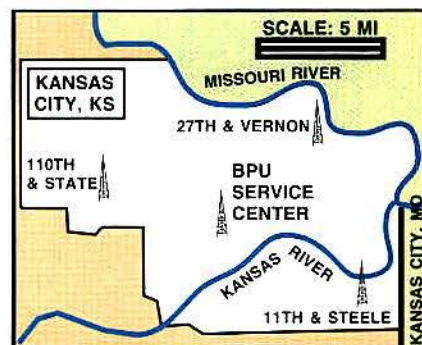


Figure 1. Three strategic tower sites and a central controller located at the heart of the service area allow the Kansas City, KS, Board of Public Utilities' 800MHz radio system to cover a 125-square-mile metropolitan area.

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number of service decisions. The conventional radio system had provided paging to about 150 users. Paging was accomplished through a dispatcher, rather than by direct access via the telephone system. Paging via the trunked system was deleted because direct telephone access paging was more economical and exceeded operational needs. All users were converted to the telephone paging system.

Supervisors and other designated personnel had been authorized for telephone interconnect services on the conventional radio system. This feature permitted supervisory personnel to make telephone calls through their radios and to reach suppliers, non-radio-equipped office personnel and employees during emergency situations while off duty. These same people had been issued cellular telephones during the Midwest flood of 1993 to accommodate communications during that emergency. After comparing the cost of full-interconnect to cellular use, and considering the possible tie-up of the trunked radio system because of telephone interconnect users, this option was also deleted. Only the BPU radio maintenance personnel would have the telephone interconnect capability.

Data transmission on the trunked radio system was also desired. However, the BPU was not prepared to source-transmit the desired information (i.e., trouble tickets, connects/disconnects, maps, etc.) at the time the radio system was to be implemented. The compromise was to purchase the radio equipment data-ready.

The design required a new radio building and tower location adjacent to the service center. As the design progressed, costs were identified to interface console communications between the Service Center Trouble Board Dispatch Center and the new radio building. Transition plans from the old dispatch center (two

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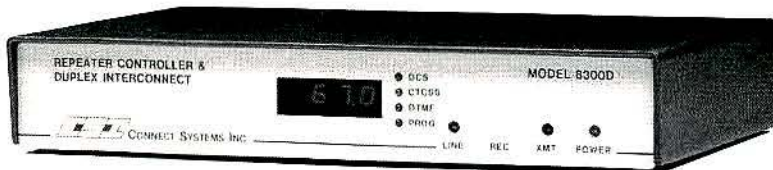
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rooms) to a more functional dispatch area were developed. The new dispatch area was assigned an area adjacent to the existing center. Space designated as the troubleman ready room was to be remodeled for this function. Coincident with these requirements, the desire to develop more office space in the Service Center surfaced. After development of an economic analysis, which encompassed the cost of office space, the cost of extending circuits and the cost of expanding the radio building, the option to increase the radio building for a dispatch area was the winner.

The procurement of the radio system was initiated in early 1994. Separate contracts were issued for a microwave system, a site construction and the trunked radio system.

The microwave system consisted of a 10GHz microwave radio with eight T-1 channels from the new Electric Service Dispatch Center (ESDC) to the three base site transmission points.

The construction contract implemented the one base site at 27th and Vernon and the new ESDC site. Tower construction was also included in the construction work.

The trunked radio system included the



Chris Knight, BPU senior radio technician, uses one of 12 Motorola Centracom Classic CRT consoles included in the radio system upgrade.

purchase of seven radio channels, 12 dispatch consoles, 100 portables and 500 mobiles or desk sets.

In anticipation of future requirements, options were priced with the original requirement. These included:

A. A trunked mobile radio system with repeater station compatible with FDMA with no modifications and with analog voice capability.

B. A trunked radio system with repeater stations compatible with FDMA with no modifications and with digital voice capability.

C. An automatic vehicle location (AVL) system.

Option A added about 1.3% to the contract price with options B and C adding 3.9% and 8.4%, respectively. Option A was originally conceived to provide flexibility in adding channel capacity, given the lack of 800MHz frequencies. FDMA technology was not authorized in the frequency band assigned to utilities. Consideration of future consolidation with Kansas City, KS, government agencies would supply some additional channels. For these reasons, this option was discarded.

The price for options B and C was too high. Subsequently, these options were also eliminated.

In 1995, contracts were awarded to Motorola for the 800MHz Smartnet trunked radio system, Harris Farinon for the microwave system and J.E. Dunn for the construction.



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Successful acceptance of the fixed radio portion of the trunked radio system was completed in February 1996. Rollout of mobile and desk sets was completed in six weeks ending in July 1996.

Installation of mobile and portable radios required coordination between many elements of the BPU. Vehicles were moved by BPU personnel, because of liability considerations, to the designated area for radio installation. Old radios were removed

and returned to the BPU radio shop. Training of affected crews was required the following workday to assure continued effective communications and operations. This coordination was established through the development of a detailed schedule by Motorola, which listed every vehicle and the date work was to be accomplished.

In-service training

A "train the trainer" concept was also



Rack equipment being readied at the 110th and State base site. The total system for all three base sites uses 21 Qunatar repeaters.

established. A small group of individuals from each functional entity of the utility was trained on the equipment. This group in turn trained each of the individuals with new radios.

Information was disseminated through a newsletter, *The Radiogram*, to all managers, supervisors and the cadre. The newsletter was kept simple, addressing one topic with each issue. The first issues described the system, how it worked and why it was required. Subsequent issues published the rollout schedule for each section. Positive feedback was received from managers in that "At least we know what is going on."

Talking the talk, walking the walk

The radio system has operated successfully. It received its first real trial by fire on Oct. 22, 1996, when the Kansas City area was hit with a freak, early snowstorm that dumped six inches of wet snow on trees still bearing fall leaves. Widespread loss of tree limbs and subsequent disruption of power lines caused a temporary loss of service to an estimated 20,000 customers. We achieved as high as 50% loading of our radio system, with almost no busy periods during the seven-day effort it required to return the electrical grid to normal.

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Solar power for remote communication systems

Gather the data needed to make business decisions on employment of solar power systems at remote sites.

By Donald E. Koehler

Articles in *MRT* (1) have made a good case for powering remote sites with solar energy, but most communication business owners still ask, "Is it for me?" Because of recent advances in both solar panel and battery efficiencies, "alternate energy" power is increasingly the better option for those remote sites not served by reliable commercial power systems. As environmental restrictions tighten, fuel-powered systems will become even more costly.

To find average daily insolation for a specific remote site, try these formulae:

$$\text{Daily Aver} = \frac{S_o}{\pi} \left(\frac{\bar{d}}{d} \right)^2 [h_o \sin \phi \sin \sigma + \cos \phi \cos \sigma h_o],$$

or, expressed in a slightly different manner:

$$\text{Daily Aver} = \frac{S_o}{\pi} \left(\frac{\bar{d}}{d} \right)^2 [h_o \sin \phi \sin \theta + \cos \phi \cos \theta (h_o)],$$

where

$$\frac{\bar{d}}{d} = \frac{1 - e^2}{1 + e \cos v}$$

Find the angle of declination with

$$\sigma = \sigma_o \sin \theta_d \text{ or expressed as } \sigma = \sigma_o \sin(\theta_d)$$

where σ_o is obliquity

Terms:

S_o is the solar constant, 1,367Wm²

σ = angle of declination

ϕ = latitude

h_o = hour angle at sunset (Consult a nautical almanac to find h_o for any given day at a specific latitude.)

e = eccentricity

$v = \theta_d - \Lambda$ (angle from perihelion), as in
 $v = \theta_d - (\theta_d)_{\text{perihelion}}$

This article discusses building an energy budget and ways to calculate, with reasonable accuracy, the total *solar insolation* available at your site. Major system components are briefly discussed and a list of information and supply sources is provided.

Power budget

Creating a communications system power budget is an exercise in detail. If you choose to use an engineered or turnkey system, budget information is still required by the contractor that builds the solar system. The time you invest in preparing the power budget document is money saved in consultant fees. The power budget, in its simplest form, records the amount of energy used (in watts) by your communications system components. If the technical data provided with your equipment seems fuzzy, the component chassis usually has a label that lists the power consumed.

In extreme cases, such as with used or surplus equipment, I have taken the fuse value and the voltage rating and calculated a wattage for the unit. While this is sloppy at best, it does give you a figure to work with on your power budget calculations. Take the time to calculate the use time of transmitters vs. receivers and the difference in power consumed.

If the bulk of the remote site equipment will be powered by alternating current, do not forget to add a percentage to account for conversion loss within an inverter system. Even modern inverter systems may suffer as much as a 10% conversion loss. In the case of dc-only systems, allow for at least 5% loss, including inefficiencies in cables. Do not forget to include energy used for lights, fans, test equipment and any sanitation devices. Now, even with all of that data recorded, we are not quite finished yet.

This data now must be expressed in watt-hours. Quite simply, it is a question of "How many watts did your equipment use, and for how many hours did your equipment operate?" For example, if you run a 100W light bulb for a full day, you have used 2,400 watt-hours. This is where billing records become invaluable in determining the actual amount of power consumed.

It is possible to build a solar power system and add additional panels and batteries if your original calculations were off a bit. In real life, this may be the less expensive alternative to buying too much in the beginning. You can find sample work sheets for this power budget process at www.sunelco.com/home.html, one of many excellent solar information "pages" on the World Wide Web. Other companies listed offer software, both IBM- and Macintosh-compatible, to perform these chores. Once you have determined the total watt-hours used by

Koehler teaches at the University of Alaska, Anchorage.



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your equipment, you can begin to calculate the solar insolation of your site.

Solar insolation is a measure of the amount of usable solar energy falling on your site. In theory, this is $1,367 \text{ Wm}^2$. This theoretical value is not obtainable for most of the world, because potential energy available is affected by latitude, angle of declination, eccentricity, obliquity, apparent seasonal movement of the sun and most of all, weather. (See the

sidebar on page 18 if you are a rocket scientist and want to do the math.)

Latitude and total hours of sunlight are the real factors to worry about. Altitude has more to do with weather than solar gain. Your latitude can be obtained at a local airport or, in the United States, topographical maps usually show latitude. For really remote sites, a hand-held Global Positioning System (GPS) unit will provide acceptable accuracy in determin-

ing latitude. Cross-reference the latitude figures with a naval or aeronautical almanac to derive the mean hours of daylight, winter and summer.

If your library doesn't have these reference materials, check with your local airport. The flight controllers or fixed base operator should be able to give local sunrise and sunset times for December 21 and June 21, the shortest and longest days of the year, respectfully. Weather, and resultant cloudy days vary widely, so its best to check with your regional weather forecast center for the percentage of cloudy days in your region.

With these figures (total power budget in watt-hours, solar insolation for your site and the percentage of cloudy days) in hand, you are ready to size the system you need to power your equipment. Panel size (in watts) \times available solar energy should more than equal your calculated power budget. For example, a 50W panel, used on a sunny, summer day may yield as much as 500 watt-hours. Be sure to add a percentage to account for cloudy days where panel output is low or reduced due to loss of sunlight.

Equipment selection

The type of components you choose will determine the real cost of power to your site. A basic system comprises a solar panel, a controller (regulator) and a battery to store the collected energy. More complex systems have multiple battery banks, smart controllers, inverters, and even tracking mounts to maximize the energy collected per panel. Each of these components plays an important role in the final system cost.

Sites located within 50° north or south of the equator, with generally sunny weather, can use fixed panel arrays, which allow for a seasonal "tilt" factor. Some site owners I have worked with have elected to use tracking mounts for their panels. These motorized frames move during the day and point the panels toward the sun for maximum power collection. This is an important consideration if your site has limited space. The down side to this efficiency is the increased maintenance workload and the potential for wind or storm damage.

Speaking of damage, the panels you purchase should contain "bridging diodes" which allow the panel to produce electricity even if damaged or shadowed. This is an important consideration if your site is subject to storms or vandalism.

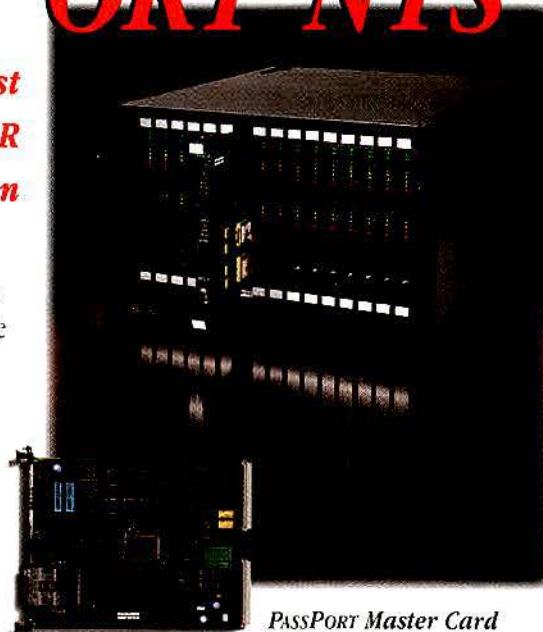
Controllers or regulators are required on all but the most basic of systems. Do *not* leave an unattended solar panel connected to a battery! Controllers act to regulate the voltage and current fed into

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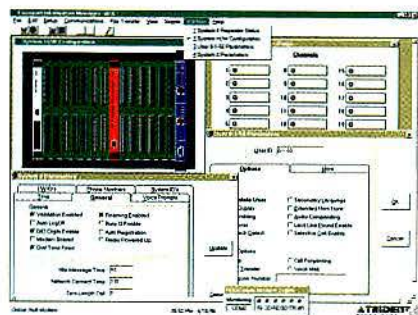
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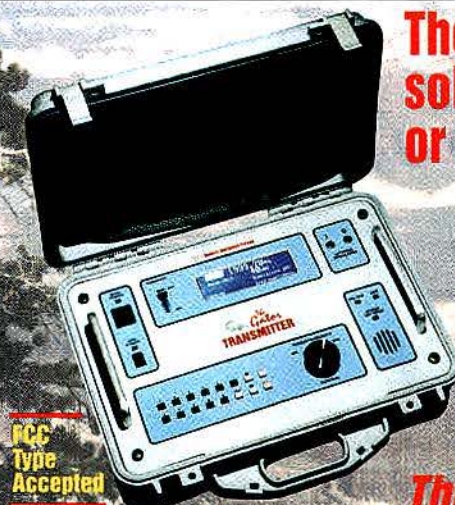
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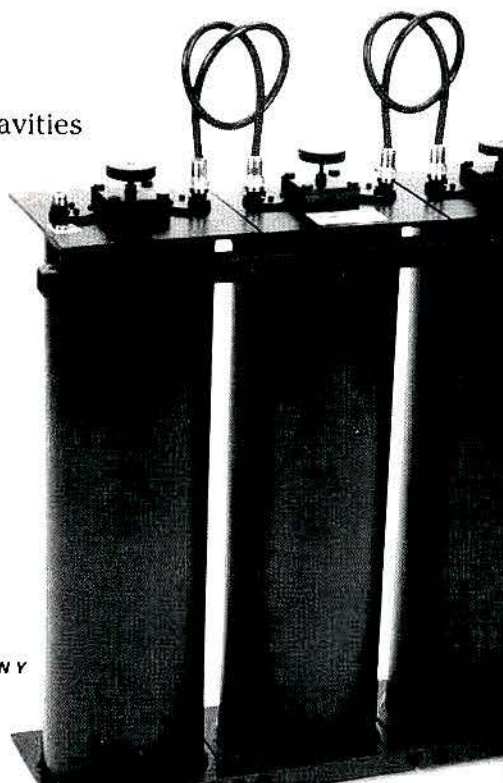
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■ Direct Power and Wind, 3455 A Princeton, NE, Albuquerque, NM, 87107-2027, 505-889-3585, dirpowdd@indirect.com

■ Photocomm, 7681 E. Gary Road, Scottsdale, AZ 85260-3469, 800-223-9580, 72731.1235@compuserve.com

■ SES Solar Electric Specialties, P.O. Box 537, Willits, CA 95490-0537, 800-344-2003, www.solarelectric.com

■ Siemens Solar Industries, 4650 Adohr Lane, Camarillo, CA 93012, 805-482-6800, www.solarpv.com

■ <http://sysrv9.nrel.gov/> National Renewable Energy Lab (basic information)

■ www.alt-energy.com/aetoc.htm (worksheets and more information)

■ www.aral.com/enrenew.htm (the mother of all solar link pages!)

■ www.sunelco.com/home.html (worksheets, new and used equipment)

■ And visit the Jade Mountain site, www.jademountain.com/index.htm, for fun, if for no other reason. Their catalog seems to list everything from solar panels (new and used) to kerosene powered refrigerators to LED arrays that save energy.

your battery bank. This same controller can switch between battery banks, provide equalization voltages and, if the battery bank is "full," divert power to an alternate load, such as a resistive heater. Some "smart" controllers will track battery bank energy input and output. Energy flow and rate information is valuable for maintaining the long-term health of your system. Advanced controllers will send this energy information back to your office via a telephone line, radio link or SCADA system as part of your overall site environmental monitoring.

Flooded-cell, lead-acid batteries generally represent the best value for storage capacity, ease of maintenance, useful life and size. Smaller installations, or those with extremely cold climates, will usually require a different battery type. Any flooded-cell, lead-acid battery will generate hydrogen gas as a byproduct of normal charging and the equalization process. Venting of this explosive gas is essential and required by the National Electric Code, OSHA and the National Building Code. A sealed, acid-proof container with outside venting will not only meet code requirements, but it will keep corrosive gasses away from equipment. If you are planning to perform the installation of a solar system yourself, contact a battery professional in your area prior to any purchase.

Reference

1. "Powering the New Wave of Wireless Networks," N.E. Stevens, *Mobile Radio Technology*, April, 1996



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Circle (22) on Fast Fact Card

Paging infrastructure: differentiating services

Primary considerations of paging providers are protecting capital investment, allowing for incorporation of new technologies and ensuring system redundancy.

By D.A. Keckler

Radio paging's odyssey has taken it from 1950s simplicity through the development of wide-area networks in the 1960s to the establishment of satellite systems and the current mix of protocols and diverse applications. The current availability of, and demand for, multiple services places the paging providers in a position of requiring infrastructure that will help reduce churn, manage subscribers, increase revenue and differentiate that provider from competitors.

Infrastructure for providers has graduated from the original model (call input to system control to transmitter to pager), to broadly based services accommodating monitoring and remote control, in-building coverage and multiple base sites, as shown in Figure 1 below.

New coding systems added tones to increase address capacity. Simple alert paging was succeeded by tone-plus voice and both numeric and alphanumeric display.

Although alphanumeric is the most rapidly growing segment of radio paging,

many providers need to accommodate all these formats.

The availability of new frequencies is changing the type of equipment used as well, with narrowband PCS spectrum being targeted for two-way paging, and speech recognition software entering the market.

The ability to handle multiple protocols is requisite. The many analog and digital protocols include two-tone, Reach, DTMF, HSC, 5/6-tone, POCSAG, NEC and Golay. Golay is still expected to have

Keckler is Features Editor.

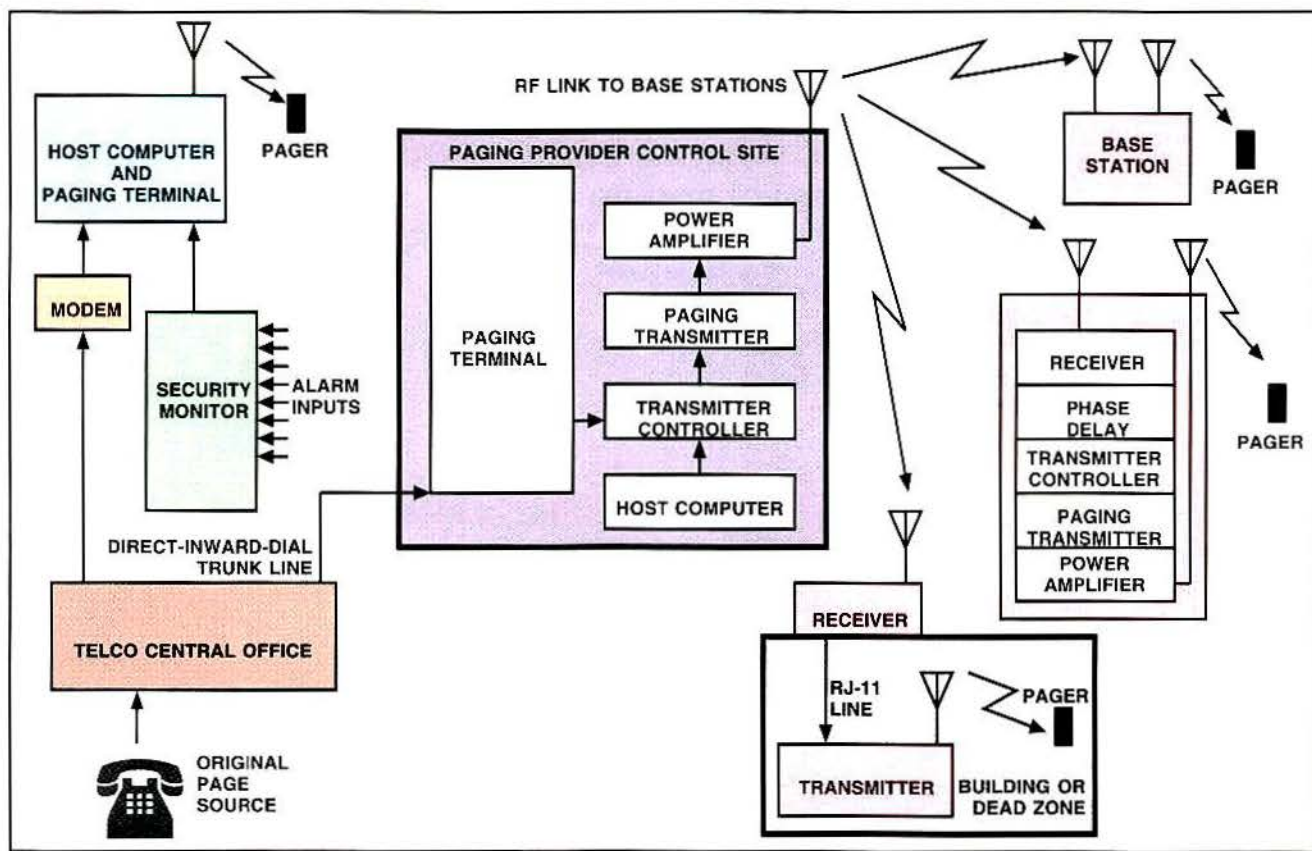
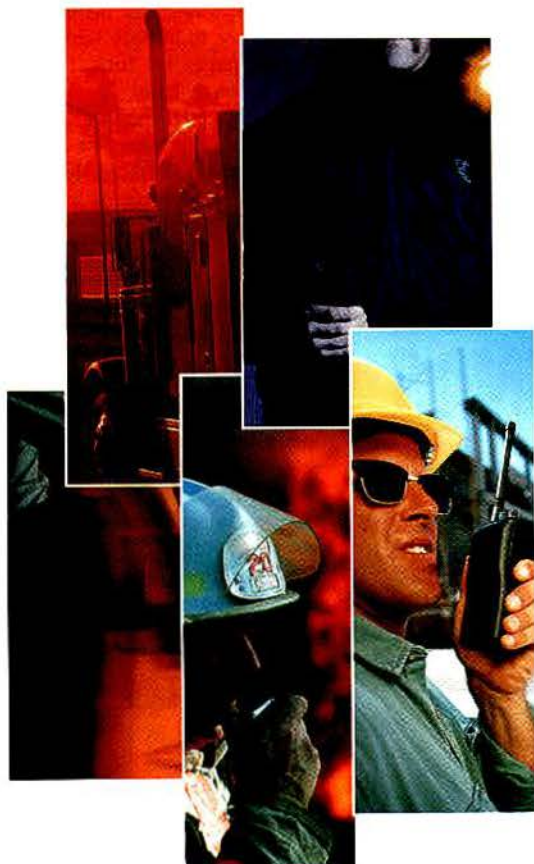


Figure 1. Typical contemporary paging with differentiated services. (Schematic based on original designs created by Eagle Telecom.)

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several years of life, and POCSAG will probably be around for at least another decade. New digital protocols, like Motorola's Flex, designed to provide greater error immunity and higher data rates, are being rapidly adopted.

Some manufacturers are promoting open architecture platforms. Wayne Morris, general manager of TGA Systems, Norcross, GA, said recently that primary considerations of paging provid-

ers are protecting capital equipment investment, allowing for incorporation of new technologies and ensuring system redundancy.

The following is a synopsis of infrastructure advances currently available in the market.

Terminals and transmitters

Paging terminals are available for both analog trunk and digital (T1 or E1) trunk

groups. Incorporated databases list details of pager type, current status and capcode and channel information. Voice processors are now available to store voice messages for user retrieval. Digital paging network analyzers monitor paging channels and can display the paging format, the frequency under observation, the total pages by format and elapsed time between batches.

Some VHF paging transmitters feature adjustable power, intelligent communications controllers to detect analog/digital mode, signal processor modules and VHF modulators and exciters to provide stability and frequency agility.

High-speed UHF paging transmitters, with power options as high as 500W, are available to support all existing protocols, including Flex. When coupled with a controller, the transmitters can be upgraded remotely using a network manager, reducing the time and cost of site visits.

Modular and small systems

Modular paging systems allow flexibility in configuration. Transmitter, receiver and monitor modules can be set up in rack-mount or panel-mount configurations. Manufacturers can also supply completely assembled paging stations with power supply and other options combined in a single cabinet. Transmitters can be programmed by a PC for as many as 128 frequencies.

Terminals specifically designed for small and medium size in-house paging systems (about 1,000 subscribers) can be used as plug-in modules to an existing PC. This allows both tone-only and numeric pages to be sent with a telephone interface or alphanumeric pages to be sent directly from the keyboard, or from remote terminals using an IXO input protocol.

Amplifiers

A unidirectional amplifier allows extension of coverage into areas where RF penetration is difficult. Channelization of the amplifier allows for high selectivity, which enables it to ignore other paging services in the same area. Units can also selectively amplify multiple 900MHz frequencies. Some models offer individual gain adjustment for each channel for continuous control.

Directors

To increase centralization of network architecture, high-capacity directors can be added to RF control systems. Capable of supporting from 350,000 to millions of subscribers on a single system, directors have high-capacity CPUs in a multiprocessor design that simplifies and upgrades

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as an operator's subscriber base grows. Migration to higher-capacity CPUs allows the Ethernet speed to be increased to 100Mb per second. By enhancing existing directors, paging operators can consolidate equipment resources and minimize costs.

Expanders

Alphanumeric paging port expanders offer higher baud rates and enhancements

to equipment. TDD access features are now available, which make a system ADA-compliant without additional lines or modems. Modem cards can be obtained in 2,400bps and 14,400bps versions.

Controllers

TNPP network controllers allow extension of coverage on a regional or nationwide basis. Statistics computers can be added to the controllers to allow customer

use information to be collected for subscriber management purposes such as reseller billing.

Multipurpose communications controllers use computer and digital signal processing technology. Windows-based GUIs, a larger system disk and memory storage for user databases and voice files can be included. Users can access voice mail and paging subsystems with a single phone call. Users can also define their own access preference, message notification schedule, greeting messages and mailbox tree. Controller systems can be expanded from four trunks to 128 trunks to accommodate operator expansion.

Encoders

Pager testers, or universal paging encoders, allow accurate measurement of pager receiver sensitivity. Line filters on inputs and outputs serve to prevent EMI in both directions.

When incorporated into a computer-based system, paging encoders can accommodate capcode increment/decrement, one-key configuration change and preprogrammed canned messages. Repeat modes, test mode and over-the-air programming are available on some computer-based encoders.

Gateways

Applications gateways allow the connection of wireless networks to the Internet. This allows new two-way paging applications such as multistage email transmission with multiple response capabilities. Services such as World Wide Web messaging allow paging operators another way to differentiate themselves in their market.

Load management modules

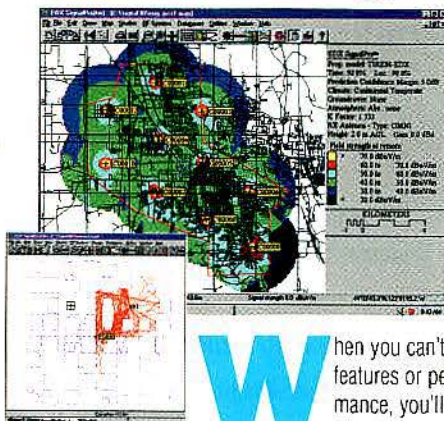
The increase in paging subscribers and differentiation of services, such as Internet gateways and automatic alarming, has created a market for products aimed at load management. Sentries, which can be added to messaging gateways, monitor incoming traffic to prevent overloading and system abuse. The sentries can identify and control traffic trends, abrupt changes in calling patterns, excessive message length and unusual leaps in volume from a single source or to a specific subscriber. Bottlenecks in traffic can be prevented by flagging messages for administrator intervention, trickling out messages, segmenting transmissions or deferring traffic to off-peak periods.

For a discussion of testing and monitoring paging infrastructure, see the feature on remote control on page 30.



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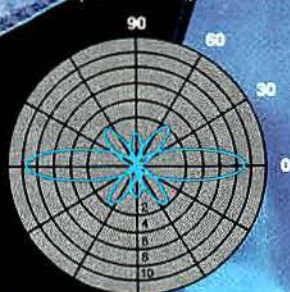
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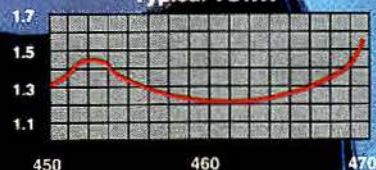


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Remote control: The sentry that never sleeps

Downtime, costly maintenance and emergencies can be limited with the use of the right remote control and monitoring equipment.

By the MRT staff

Even before Tom Sawyer found a way to remotely whitewash Aunt Polly's fence, people have looked for ways to avoid expending labor and to expedite problem solving. The combination of wireless communications and DTMF tone signaling has led to systems that reduce labor and maintenance costs, speed notification of problems and increase maintenance efficiency.

Remote systems perform both active tasks, such as base station and repeater control, and passive tasks such as data acquisition and situation monitoring. The remote control marketplace offers a variety of applications for mobile communications.

Tone remotes

Tone remote controls are usually desktop instruments with a DTMF keypad and handset resembling a telephone. Systems are generally dedicated to a specific make of base station. Units can control one to four base stations or repeaters from a single instrument. Frequently used by dispatchers, most contemporary units have liquid crystal displays for numeric and alphanumeric characters. The use of text aliases programmed into the LCD eliminates operator confusion and simplifies training.

Other information provided can include frequency selections (for at least eight frequencies) and pager capcodes. Remotes can be equipped with a built-in paging encoder and a database. This allows two-tone, five-tone, DTMF and alert paging. The database provides name verification of the paging selection, allows users to scroll through preprogrammed pager codes and names, and provides the option for stack paging of multiple users. Programmable soft key functions, display text, guard tones and function tones can be defined in the field.

Digital signal processing (DSP) removes disruptive chirps or function tones, allowing users to speak immediately without waiting for tones or key-up delays. Parallel status indication features allow the remote to reflect the true status of the base station, regardless of how many parallel remotes are tied to the base station. When the base station status is changed, the change can be displayed on all parallel remotes. Configuration programming can also be cloned from one remote to another or to all remotes on the system.

Remote systems perform both active tasks, such as base station and repeater control, and passive tasks such as data acquisition and situation monitoring.

Optional features on tone remotes include intercom, privacy and supervisor takeover.

Multiple applications

Remote systems can be used for fixed data, mobile dispatch, automatic vehicle location (AVL) and credit card verification in remote locations. The central component is a remote network processor, which is positioned between a company's host computer and the radio infrastructure. Other components are mobile data controllers, which attach to a remote radio or mobile computing device and function as a radio modem.

Such remote control devices allow utilities to remotely control critical functions via their paging infrastructure. For

example, an electrical utility can control its capacitor banks through four control channels. Motor-driven switches can be controlled by using a simple two-channel controller. Limit timers, lockout timers and even voltage sensors with set periods of lockout can be programmed to activate when adverse conditions are sensed. LCD counters can track the number of activations or aborts requested by the control center or implemented by the remote's own internal microprocessor. Controls such as this usually have non-volatile memory backup for storing system configuration and can retain data for years. Timers can be configured for more than 100 hours of duty, and counters can count as many as 999,999 cycles.

AMR

Another remote primarily affecting utilities is automated meter reading. A network of remotes can offer options such as daily peak and off-peak billing by means of real-time meter reading and cycled readings. Customer service can also be disconnected remotely from the main office instead of dispatching a field technician. Power outages and attempts to tamper with service can be spotted instantly, allowing utilities a head start on restoring service.

SCADA

Supervisory control and data acquisition (SCADA) systems generally include a radio transceiver, RS-232 modem interface and a digital and analog I/O board. The number of available inputs varies among manufacturers, but most systems provide both analog and digital inputs as well as contact closure output lines. The common speed for modems is 9,600bps. Internal memories can hold as many as 64 programmed RF channels. Available features include error detection and compatibility with Microsoft Windows for logging site activity to standard database



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files. SCADA modules generally consume little power, as low as 80µA at 12Vdc, and they can operate on one-way or two-way radio systems.

Testing, monitoring and alarming

Automatic monitoring is superseding the practice of constant human monitoring of services such as a paging system. Remote-controlled switches allow a provider to avoid system-wide failures because of a failed control link or paging transmitter. The switches send test messages over the network at regular intervals for automatic decoding by an automatic monitor connected to an alarm. Both alphanumeric and numeric POCSAG messages can be monitored in this fashion.

Paging system testers can also dial a paging terminal at predetermined intervals to activate a pager connected to the test system. The tester detects when the pager receives the signal and resets its interval timer until the next page. If the page is not delivered within the specified time, the tester automatically sends a message to the phones or pagers of appropriate personnel to indicate the need for system maintenance. Some systems allow

for the maintenance personnel to use DTMF tones to acknowledge the error notification or deactivate the alarm.

Remote monitors that check contact

Some monitors provide for as many as 240 alarm conditions of all types, including ac or dc power levels, SWR, insertion loss, temperature, intrusion, fire alarm, tower light status, RF power, battery voltages, current drain, and shelter environmental conditions.

closures also use paging services to forward notification of alarms or situations. Systems are available for either alphanu-

meric or numeric pagers, and features such as automatic redial and backup pager numbers are available. Control points and other functions can be operated from a DTMF phone. Remotes can also provide dial-up control for small alarm networks.

Several formats for notification are available. Remote monitoring paging systems can be designed to page specific individuals or groups with preprogrammed alphanumeric alarm messages. Some paging alarm systems send a text message fully describing the nature and location of the alarm condition. Systems can be as basic as two contact closure points or provide as many as 48 closure points. Internal dial-up modems can be provided to send notifications via a wide-area paging service. For campus situations where the party to be notified is physically proximate, optional small transmitters, typically 4W or 5W, are available for local paging.

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mental conditions. Alarms can be monitored, announced and acknowledged over telephone lines, mobile radio systems, alphanumeric pagers, RS-232 ports and cellular telephones. Systems are even available with internal microphones, complete with a built-in compression filter, for remote monitoring of site audio.

Some of the most recent monitor products introduced can compare measured data against operator-selected alarm limit

and perform a predetermined action on site using relay contact closures. Alerts can be sent via wireline PSTN with data reports and can be tagged for one to four recipients. Modular, expandable systems have been designed for trunked radio systems, conventional radio, paging, cellular, IMTS, mobile radio dispatch and aviation. With an expansion slave unit, some models can be expanded to handle as many as 64 transmitters or antennas.

Some new models offer virtually instantaneous processing of input channels at intervals of every quarter of a second.



The following are manufacturers of remote control and monitoring equipment of the types mentioned in this article. For a comprehensive list, refer to the December Buyers' Guide issue of MRT.

Barnett Engineering, 7710 5th St., S.E., #215, T2H 2L9, Calgary, Alberta, Canada, 403-255-9544, barnettlb@cadvision.com.

BayTech, 200 N. 2nd St., Bay St. Louis, MS 39520-4536, 403-933-5393.

CPI Communications, 1186 Commerce St., Richardson, TX 75081-2307, 972-437-5320.

Decibel Products Division of Allen Telecom Group, 8635 Stemmons Freeway, Dallas, TX 75356-9610, 214-631-0310, www.allentele.com.

DPS, 4922 E. Yale Ave., Fresno, CA 93727-1517, 209-454-1688.

Eagle Telecom International, 910 Gemini St., Houston, TX 77058, 713-280-0488.

IDA, 1345 Main Ave., Fargo, ND 58103-1631, 701-280-1122, ida1995@aol.com.

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Padcom, 2045 City Line Road, Bethlehem, PA 18017, 610-882-9940.

PageTap, 8200 E. Pacific Place #204, Denver, CO 80231-3212, 303-337-4811.

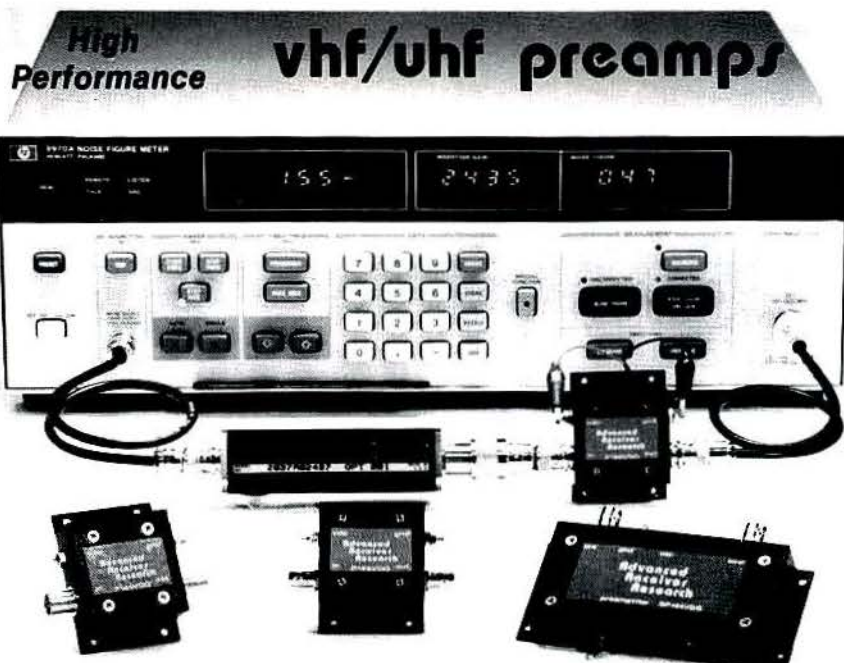
RF Industries, 7610 Miramar Road, San Diego, CA 92126-4202, 619-549-6340, 102061.2261@compuserve.com.

SynetCom Digital, 1426 Aviation Blvd. #203, Redondo Beach, CA 90278-4062, 310-379-2000.

Utility Network Services, P.O. Box 850461, Richardson, TX 75085-0461, 214-234-5935.

Visiplex, 1141-G Lake Cook Road, Deerfield, IL 60015-5235, 847-405-0771.

Zetron, P.O. Box 97004, Redmond, WA 98073-9704, 206-820-6363, www.zetron.com.



Receive only	Freq. Ranges (MHz)	N.F. (dB)	Gain Comp. (dB)	1 dB	Device Type	Price
P30VD, P35VD, P40VD, P45VD	30-35, 35-40, 40-45, 45-50	<1.3	15	0	DGFET	\$ 44.95
P30VDG, P35VDG, P40VDG, P45VDG	30-35, 35-40, 40-45, 45-50	<0.5	26	+12	GaAsFET	\$109.95
P150VD, P160VD, P170VD	150-160, 160-170, 170-180	<1.5	15	0	DGFET	\$ 44.95
P150VDA, P160VDA, P170VDA	150-160, 160-170, 170-180	<1.1	15	0	DGFET	\$ 56.95
P150VDG, P160VDG, P170VDG	150-160, 160-170, 170-180	<0.5	24	+12	GaAsFET	\$109.95
P450VD, P460VD	450-460, 460-470	<1.8	15	-20	Bipolar	\$ 49.95
P450VDA, P460VDA	450-460, 460-470	<1.2	16	-20	Bipolar	\$ 74.95
P450VDG, P460VDG	450-460, 460-470	<0.5	16	+12	GaAsFET	\$109.95
P800VDG, P830VDG, P860VDG	800-830, 830-860, 860-890	<0.6	19	+12	GaAsFET	\$119.95
Inline (rf switched)						
SP30VD, SP35VD, SP40VD, SP45VD	30-35, 35-40, 40-45, 45-50	<1.4	15	0	DGFET	\$ 74.95
SP30VDG, SP35VDG, SP40VDG, SP45VDG	30-35, 35-40, 40-45, 45-50	<0.55	26	+12	GaAsFET	\$139.95
SP150VD, SP160VD, SP170VD	150-160, 160-170, 170-180	<1.6	15	0	DGFET	\$ 74.95
SP150VDA, SP160VDA, SP170VDA	150-160, 160-170, 170-180	<1.2	15	0	DGFET	\$ 86.95
SP150VDG, SP160VDG, SP170VDG	150-160, 160-170, 170-180	<0.55	24	+12	GaAsFET	\$139.95
SP450VD, SP460VD	450-460, 460-470	<1.9	15	-20	Bipolar	\$ 79.95
SP450VDA, SP460VDA	450-460, 460-470	<1.3	16	-20	Bipolar	\$104.95
SP450VDG, SP460VDG	450-460, 460-470	<0.55	16	+12	GaAsFET	\$139.95

Every preamplifier is precision aligned on ARR's Hewlett Packard HP8970A/HP346A state-of-the-art noise figure meter. RX only preamplifiers are for receive applications only. Inline preamplifiers are rf switched (for use with transceivers) and handle 25 watts transmitter power. Mount inline preamplifiers between transceiver and power amplifier for high power applications. System S/N improvement 6-14 dB typical. Other amateur, commercial and special preamplifiers available in the 1-1000 MHz range. Please include \$2 shipping in U.S. and Canada. C.O.D. orders add \$2. Air mail to foreign countries add 10%. Order your ARR RX only or inline preamplifier today and start hearing like never before!

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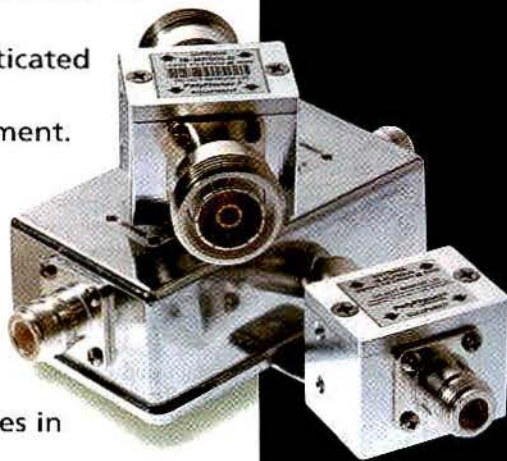
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PolyPhaser
CORPORATION

The following pages contain mobile radio, paging and cellular products and services of advertisers in this issue. Information is provided by the advertisers. For more information on these products, circle the corresponding Fast Fact number found on the card on page 85. Also, refer to the Advertiser Index on page 84 for the page reference to the company's advertisement.

BVS Gator transmitters



The BVS Gator transmitters from **Berkeley Varitronics Systems** are a cost-effective solution for measuring signal propagation, positioning antennas, setting power levels or validating coverage. Features include FCC type acceptance; full remote control via modem or DTMF control; built-in forward and reverse power meter and VSWR monitoring; and digitally controlled and regulated output.

Circle (301) on Fast Fact Card

Tower hardware



Site Advantage has introduced its new line of tower hardware. By manufacturing its own stainless-steel

parts, the company has drastically reduced the cost without sacrificing quality. Products include angle adapters, standoffs, butterfly hangers, hardware kits, weatherproofing kits, hoisting grips and more.

Call 516-582-4795 for a catalog.

Circle (302) on Fast Fact Card



Console System

DSPatch 32 from **Avtec** was developed to provide the small system user with the same features as larger systems in a smaller, affordable platform. Thirty-two ports are available to be assigned as operator workstations or lines. The system supports radio, telephone, intercom, multifunction paging and autodialers.

Circle (303) on Fast Fact Card



Universal laptop dock

The 8800 series universal laptop dock from **Scientific Dimensions** extends the life cycle of any laptop docking station application by supplying maximum flexibility with a fully universal, upgradeable and expandable mounting system. The series features rugged port replication using "floating" pin connectivity. The system integrates a security lock mechanism, LED power indicator and is supported by a heavy-duty locking tilt and swivel base.

Circle (304) on Fast Fact Card



SCADA, telemetry systems

Economical, easy-to-use, **ULTRAc** wireless SCADA and telemetry systems from

Zetron feature PC-based centrals; use of existing radio systems; NEMA cases with battery backup; PLC monitor and control systems; PLC communication via MODBUS; and voice and paging alarms over phone or radio via SentiVoice and SentiDial product lines.

Circle (305) on Fast Fact Card



Wireless communications service monitor

Hutton Communications is an authorized stocking distributor for IFR. The COM 120B is an advanced wireless communications service monitor providing lightning-fast operation.

800-442-3811; Fax 972-239-5264

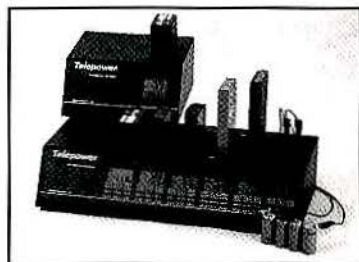
Circle (306) on Fast Fact Card

Lightning block protector



The Micro Lightning Block Protector from **PolyPhaser** was engineered as a single broadband device for 980MHz to 2.6GHz, meeting the customer's needs in the PCS and other microwave markets. It exhibits one of the industry's best RF and surge performance in a fully weatherproof, small footprint.

Circle (307) on Fast Fact Card



Conditioner upgrade kit

JBro's upgrade kit enables NiCd battery maintenance systems to condition and analyze NiMH batteries. The system uses software algorithms unique to NiMH battery formats.

JBro Batteries

800-323-3779; Fax 800-237-6435

Circle (308) on Fast Fact Card



Ultra-compact portable

The **Vertex VX-10** portable transceiver is available in both VHF and UHF versions. Both feature 5W of power, and each is available in a 102-channel, 16-key version or a 40-channel, two-key version. Despite the small size, the VX-10 is commercial grade—designed to withstand rugged use and abuse typical in public safety, light industrial and business. The radio has been tested to applicable MIL-STD 810 C/D/E parameters.

Circle (309) on Fast Fact Card

1997A Buyers' Guide



Tessco's 1997A Buyers' Guide features seven sections covering infrastructure products, mobile and portable accessories, antennas, bench equipment and test and maintenance gear—with complete specs and guaranteed pricing. It lists more than 17,500 products from 262 manufacturers. It's available on a complimentary basis to qualified service organizations by calling 800-472-7373, faxing 410-472-7575 or by visiting their web site <http://www.tessco.com>

Circle (310) on Fast Fact Card



Dry loads and attenuators

New RF dry loads and attenuators from **Bird Electronic** provide premium quality and performance at competitive prices: 2W-300W, conservatively rated; dc-4GHz (dc-2.4GHz for 50W-300W models); SMA, N, TNC, BNC and IEC 7/16 connector options. Call 216-248-1200 or e-mail sales@bird-electronic.com

Circle (311) on Fast Fact Card

Tower-mounted preamps



The new **TX RX Systems 423-series** compact tower-mounted preamplifier features a lightweight, compact design ideal for populated towers. Designed for the 800MHz and 900MHz bands, this series delivers superior intermodulation performance to combat today's hostile RF environments. When cost and performance count... think 423 series.

Call 716-549-4700

Circle (312) on Fast Fact Card



Eliminate water migration

CommScope solves common water migration problems at cellular and PCS sites. The revolutionary design of the Cell Reach cable not only eliminates water migration, but also provides broadband capabilities guaranteed at 1:10:1 VSWR to 2GHz, lower inventory costs and lower system costs.

Call 1-888-CELL REACH (888-235-5732) for more information.

Circle (313) on Fast Fact Card

MIDLAND[®]USA

220MHz trunking radios

The new line of 220MHz narrowband trunking equipment, which consists of mobiles, portables and repeaters, delivers crisp, clear audio and wide-area coverage. Based on linear modulation technology (LMT), the new radios from **Midland USA** offer high-speed data transmission, 14.4kbps @ 5kHz and voice capability.

816-241-8400, ext. 1690
Fax 816-920-1144

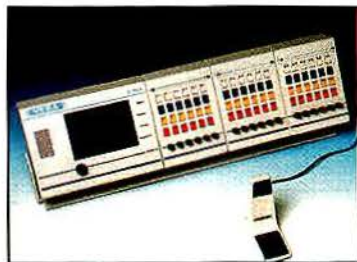
Circle (314) on Fast Fact Card

Heavy-duty paging antenna

The **HD9-92040** 9dBd omnidirectional paging antenna from **Hustler** features a solid mechanical design and a 2" fiberglass radome rated for 150mph winds. The 920MHz-940MHz antenna offers outstanding fringe area performance and is dc-grounded for lightning protection.



Circle (315) on Fast Fact Card



Desktop control console

The model C-6024 from **Vega** offers ease of use with its touchscreen and independent switches for line selection and instant PTT. The microprocessor-based, multiline, multi-format, radio console handles as many as 24 lines.

Circle (316) on Fast Fact Card

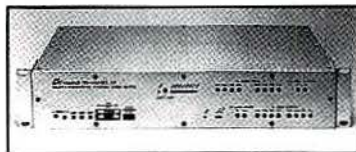


Comms system analyzer

The **Motorola R-2670** features windowed displays with soft key controls and dedicated test screens that access secure RF testing and signal encoding/decoding functions. The unit tests Motorola SmartNet, SmartZone and Astro trunked mobile and portable radios under actual signaling conditions.

Please call 800-505-TEST
Web site: <http://www.mot.com/test>

Circle (317) on Fast Fact Card



Transmitter steering controller

The TSAM-1 transmitter steering controller from **CTI Products** works with existing comparators and receiver voting electors to steer eight transmitters. It includes fully programmable control tone generation and CTI Products' exclusive Smart-Steer algorithm. It is expandable to 64 transmitters. 513-595-5900

Circle (318) on Fast Fact Card

Multichannel remotes



The Alpha series remotes from **CPI Communications** display the channel/system number, as well as allow the user to tag them with a 10-character name. Remote systems are available for the various radios from the following manufacturers: Motorola, Kenwood, Radius, E.F. Johnson and Midland.

Call 800-869-9128 for more information.

Circle (319) on Fast Fact Card



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Circle (320) on Fast Fact Card



Cable, antenna analyzer

Site Master is a precision analysis tool that measures SWR, return loss and distance-to-fault on both analog and digital RF transmission lines. The unit from **Anritsu Wiltron** has a frequency range of 25MHz-3,300MHz and rejects external RF interference.

Circle (321) on Fast Fact card



1.5GHz E1 radio

The new 1.5GHz E1 radio from **Microwave Data Systems** for the international 1.5GHz ITU band features more than 4bps/Hz using QAM; all digital—no adjustments—100% software controlled; high sensitivity; compact 2RU package includes duplexers; local and remote diagnostics.

Contact MDS at 716-242-9600 or www.mdsroc.com

Circle (322) on Fast Fact Card



Preset dc power supply

The model PPS-4A from **Astron** allows the user to preset the voltage and current without actually loading the unit. The supply is completely solid-state and suitable for bench or rack-mount operation. The unit delivers 0V-16V at 0A-4A and can be adjusted continuously throughout the output range.

Circle (323) on Fast Fact Card



Desktop power supplies

Sleek, low-profile desktop power supplies from **DuraComm** measure 1 3/4"H x 7"W x 7 1/16"D with no top-vent louvers. All models weigh less than three pounds. The units are available with 10A, 14A, 18A and 25A, pre-set 13.8Vdc. The units are 80% efficient. Features include MOV full-input ac line protection; ac/dc line filtering.

Circle (324) on Fast Fact Card



Decoder

The DC440 from **Optoelectronics** decodes and displays 50 CTCSS tones, 106 DCS codes and 16 DTMF characters. The unit displays DTMF characters at the same time as CTCSS or DCS on a two-line LCD. A serial data jack permits connection to a PC for remote control and data logging. NiCd batteries are available for mobile operations. 2"H x 5"W x 4"D.

Circle (325) on Fast Fact Card



Trunking antenna

The Decibel Products Division of **Allen Telecom Group** has developed the ASPA977HVSE — the first omnidirectional antenna in the 800MHz trunking market to offer adjustable electrical downtilt. Using Decibel's industry-leading Vari-Tilt technology, it offers continuously adjusting electrical downtilt of 0° to 5° in 1° increments and provides 8.5dBd of gain in the 806MHz-869MHz range.

Circle (326) on Fast Fact Card



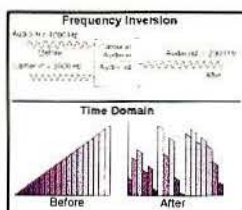
Repeater panel

The TP-163 from **Connect Systems** is the only shared repeater panel available with 112 DCS codes, 51 CTCSS tones, two RS-232 ports and software permitting either online or offline programming.

Call CSI at 800-545-1349

Circle (327) on Fast Fact Card

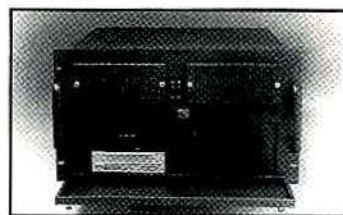
Scrambling for two-way



Today the level of security required in the two-way industry simply boils down to—What can you afford to lose if your conversations are heard by others? **Selectone** offers clear choices to your questions with time and frequency domain scrambling.

800-227-0376
www.selectone.com

Circle (328) on Fast Fact Card



Voice processing platform

The new Prism open-architecture radio paging terminal from **TGA** is based on Windows NT, Pentium CPU and Dialogic SCSA bus. Applications include radio paging; voice, fax and e-mail; one-number access; test-to-speech; voice recognition; and alphanumeric dispatch. Call Prism Telecom at 770-441-2100 or sales@tga.com

Circle (329) on Fast Fact Card



Fast-fitting connectors

Three fast-fitting RingFlare connectors from **Andrew** for 7/8" LDF5-50A low-density foam coaxial cable automatically flare the cable as they are tightened, drastically reducing installation time without compromising electrical or mechanical performance. The simple, two-piece threaded connectors feature low VSWR, low intermodulation and self-lubricating O-rings.

Circle (330) on Fast Fact Card



RF power amplifier

Designed for use in conjunction with 900MHz radio modems, this half-duplex modem-compatible RF power amplifier from **VoCom** features TX/RX switching times of 25µs or better, as much as 25W output with as little as 200mW input, 13.8Vdc operation and adjustable output power to maximize efficiency.

Circle (331) on Fast Fact Card



Trunking logic controller

LTR trunking controllers from **Trident Micro Systems** make the move to UHF trunking easy. The Raider is a full-featured dispatch trunking controller with CTCSS/DCS, CWID and repeater disable. The Marauder (shown) uses a high-performance telephone interconnect with two- or four-wire compatibility, audio companding, dial-click decode and encode and ID-specific access levels.

Circle (332) on Fast Fact Card

In-building RF distribution



The patented Signal Tap from **Kaval Telecom** allows you to "tap" into live coaxial cable without the use of splitters and connectors to selectively control where and how much RF signal is radiated. The unit connects in minutes, at a fraction of the cost of other solutions. It is available in all frequency bands from 30MHz–2GHz.

905-940-1400; fax 905-940-1402

Circle (333) on Fast Fact Card

Portable as base station

The Jerk and Run EC series units from **BK Radio** combine a portable



radio with an RF amplifier and a vehicular charger, allowing the portable to be used as a base station. The units allow any Bendix/King VHF or UHF portable to be inserted into a metal housing that charges the battery. A spring-loaded mechanism can be released to eject the portable.

Circle (334) on Fast Fact Card



High Q bandpass filters

A series of high Q bandpass filters offer tunable quarterwave cavities in a variety of diameters for increased Q, selectivity and low loss while suppressing interference from 30MHz to 950MHz. Available from **Micro-wave Filter**, these filters can be used as preselectors or to clean up spurious transmit signals. Five sizes are available in single, double and triple cavities. The units have rotating loops and an adjustable resonator for field tuning.

Circle (335) on Fast Fact Card

Technically speaking

(Continued from page 8)

the operating voltages of the various circuitry.

Because a fully equipped radio shop has a computer anyway, the reference measurement data can be stored on computer for quick and easy recall. A simple table can be generated within the computer program to record the pertinent reference data. Besides the actual measurement data, the make and model of equipment used to measure the data should be included as notes with the table, as well as the conditions under which the data were measured. For example, a table for signal levels measured with -80dBm signal into receiver RF input might look like this:

Point of measurement	Measured level
Receiver side of antenna relay	"X" dBm
Base of RF amplifier transistor (Q1)	"X" dBm
Collector of RF amplifier transistor (Q1)	"X" dBm

Note: Measurements made with signal level of -80dBm at receiver input using

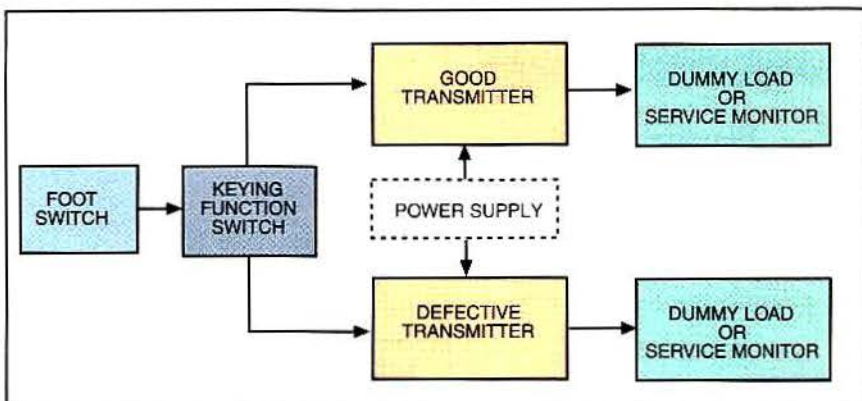


Figure 4. To free both hands, a foot switch can be used. A simple switch can be used to transfer the foot switch from one transmitter to another.

Model "X" low capacity scope probe with Model "X" spectrum analyzer.

Sure, the loading effect may be serious and the *absolute* measurements may not be valid. So what? We are not worried about absolutes here—only *relative* levels of the bad set to the good set. Loading effects will be the same for both sets so the comparisons will be valid.

Using the techniques presented here will be much easier if you prepare the workbench setups beforehand. Unless arrangements are made convenient it is unlikely that they will be used at all. Adequate workbench space and switching setups are necessary in order to use these procedures to best advantage.

Until next time—stay tuned!



NEW!

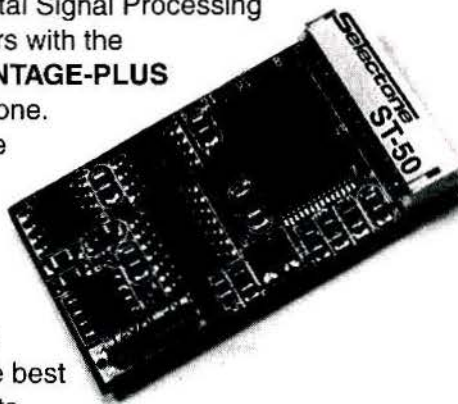
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The numbers game

By Robert H. Schwaninger Jr.

Numbers can be fun, or so my accountant says. Of course, if I really listened to my accountant, I wouldn't be awake for long, because he's only slightly more interesting than my term life salesman. Still, there is that fascination that comes with talking about big numbers. And if you stick a dollar sign in front of them, then they're suddenly really neat.

So, the other day when I tripped across Nextel Communications' earnings report for 1995 and 1996 as published in "The Journal" (cool guys don't say "The Wall Street Journal"), I became obsessed with the numbers. Nextel reports that it lost \$556 million and some change in 1996. It also lost about \$331 million and carfare in 1995. That's almost \$900 million in two years! The report reminded me the late Sen. Everett Dirksen's (R-IL) com-

Schwaninger, MRT's regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.

ment about the U.S. budget: "A billion here and a billion there, and soon we're

talking about some real money."

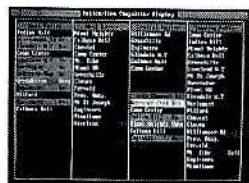
But how much *are* we talking about? I mean, it's hard to fathom that much dough just disappearing into the economic abyss. When the numbers get that high, I need a point of reference. I've got to find some comparisons to get a handle on that much cash being flushed. So, let's just see what losing that much "moola" really means.

How much was that?

If Nextel had used the money it lost in 1996 to buy, say, Death Valley, CA, it could have snatched up that neat little parcel for about \$250 an acre. All 3,300 square miles of pristine desert could have been part of the company's portfolio. They could have turned the whole thing into a theme park and cleaned up.

At about five bucks a whack, Nextel could have bought those stupid-looking crown air fresheners for every car in America. Or, speaking of transportation, they could have hired a taxicab to take them to Jupiter and back at about a buck a mile, and they would have had money left over, in case they had to pay a luggage charge.

The average cost of a ticket to a St. Louis Cardinals baseball game is about \$12, and the stadium holds about 50,000 people. So, with its 1996 losses, Nextel could have bought out the stadium for every home game over the next 10 years and still have had \$100 million to spend on parking, hot dogs and beer. (Well, the beer might have pushed it farther into the red.)



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Regulating technology

If Nextel had agreed to pay a buck for every cubic foot of water that flowed over Niagara Falls, its 1995 and 1996 losses would have kept the tap on for over an hour. If it got a great deal on tone-only pagers at about \$10 a pop, over the last two years it could have installed one on every cow in America. For \$20, it would have to settle for every pig. For fifty-bucks-a-beeper, they'd only get sheep (who, as we know, prefer alphanumeric).

In an effort to get great P.R., how about if Nextel had given a \$100 gift certificate to each new set of parents who gave birth in the United States last year? No way, you say? Too much? Not really, since that would have set the company back only \$400 million, which is still \$150 million less than it lost.

Okay, we're starting to get the picture here: Nextel lost a lot of money. So, how can the company turn itself around? I propose door-to-door sales, using the Girl Scouts. They're cute, tenacious, well-distributed across the country, and they could probably use an additional product line. There are about 3.2 million of those cookie sellers ringing doorbells across the United States. If Nextel paid each one about 25 bucks a month, it would have the sales force it needs to push its products.

"Wait a minute," you say, "Who's going to make all the stuff Nextel is going to sell?" Well, if you compare the company's losses for 1996 to the gross domestic product of some foreign countries, you can easily see that Nextel could afford the entire workforce of many small emerging nations. If the Girl Scouts agree to a commission plan instead of straight salary, Nextel could hire the entire populations of Granada, Kiribati, the Marshall Islands, Slovenia and Slovakia for less than \$400 million (and probably pick up Suriname in the bargain).

Looking at revenues

To be fair, Nextel did bring in revenues of more than \$330 million in 1996. That is, for every dollar they made, they spent about \$3. Try this at home, and without credit you'll end up on welfare in about a month—like Nextel, which announced that Motorola is lending it another \$400 million or so in financed equipment. Now, you try to get Motorola to finance your purchases with numbers similar to Nextel's. Can you say "Buzz off, deadbeat"?

Speaking of revenues, current figures have Nextel serving about half of the SMR customers in America, or about one million subscribers. Nextel also reports revenue per unit of about \$30 per month, while most SMR operators are making closer to about \$20 per month per sub-

scriber. Using Nextel's revenue numbers, it is clear that Nextel lost more money in 1996 than the gross revenues for the entire SMR industry!

Those same figures have the SMR industry growing at a rate of about 13% per year. Assuming that Nextel captures half of the new SMR customers, and its cost of doing business remains constant (\$900 million a year), Nextel will begin to break even in about 20 years. Of course we aren't taking into account the fact that the 7% increase in revenues is offset by Nextel's debt obligations, the interest on which might wipe out these gains.

Critics of my little analysis might point to Nextel's increase in total revenues between 1995 and 1996, which showed Nextel gaining \$160 million in fresh cash flow. I might counter with a look at Nextel's earnings per share, (2.31) in 1995 and (2.50) in 1996. The Titanic went down slower.

So what?

Right now, with about 25 bucks, you could buy one share of stock in each of the major paging companies and one share of Nextel, too. That's what investors call a "diversified portfolio."

Mobilmedia took Chapter 11, Pocket Communications went feet-up, and many of the wireless carriers use more parentheses than periods on their earnings reports. Still, the FCC and Congress have (and promote) the impression that holding a radio license is tantamount to holding a ticket to riches.

Technology isn't regulated these days, it's squeezed—one investment dollar at a time. When even the largest carriers cannot make a profit, what does this say about our industry as a whole? It says that the priority—bringing desired service to the public at a price it will pay—has gotten lost in the equation. Instead, the balance sheet shows the effects of federal greed and corporate greed, in a race to see who can make the most before the bubble bursts.

Our industry requires the trust of the financial community, including banks, underwriters, brokers and venture capitalists. That trust, which we used to take for granted to get a new service or technology off the ground, is quickly eroding. Lenders aren't fools, and only a fool lends money to a company that has to spend a billion dollars at auction before the first antenna goes up. The risk is simply too great. Better to invest in the company that supplies the others with red ink. A look at "The Journal" shows that our giants have joined the federal government as major consumers of that commodity.

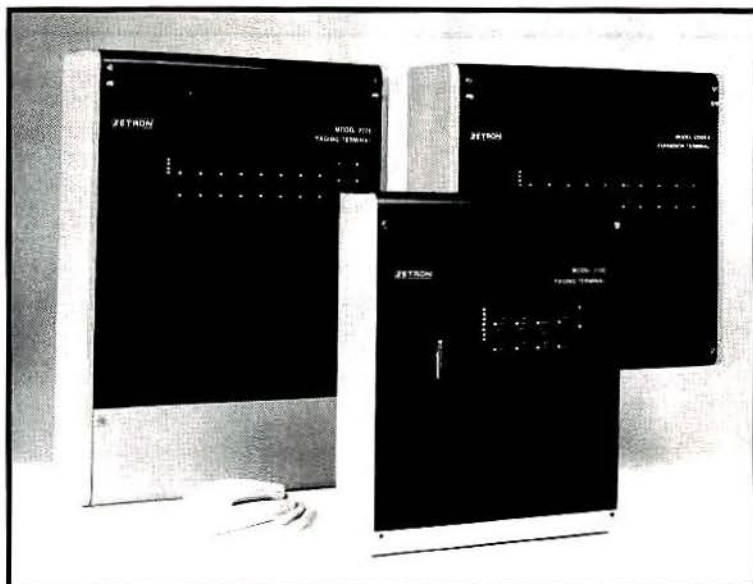
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Allen Telecom appoints Electro-comm as super distributor

Electro-comm Distributing, Denver, was appointed as an Allen Telecom "Super Distributor." The Allen Telecom Group, Cleveland, consists of eight divisions including Antenna Specialists and Decibel Products.

A/S and Decibel products are in stock in Electro-comm's warehouse in Denver, in-

cluding mobile antennas, base antennas and filter products.

Electro-comm Distributing also added password-protected product search capabilities to its web page. Electro-comm's customers can get the latest pricing 24 hours a day as well as find products by description, vendor or category.

Motorola targets smartcards for major new growth initiative

Motorola, Schaumburg, IL, is entering the global smartcard business. It has introduced a new business unit, the Smartcard Systems Business (SSB). Motorola's SSB will offer a portfolio of products that support multiple microprocessor-based smartcard applications and offer security. By driving open industry standards and developing new card and terminal operating systems, application programming interfaces (APIs) and developer's tools, Motorola plans to shorten the time required for third-party developers to create smartcard software and load new applications during the card's lifetime.

This new unit will be independent of Motorola's Semiconductor Products Sector and will reside within the Land Mobile Products Sector in Schaumburg. The new business will be headed by Mark Davies, vice president of Motorola's Smartcard Systems Business.

PageMart Wireless to supply paging products to Radio Shack

PageMart Wireless, Dallas, has entered an agreement to supply paging products and services to Radio Shack, a nationwide paging retailer. PageMart has begun shipping product to more than 3,700 company-owned Radio Shack stores, which expect to begin selling pagers nationwide during the second quarter of 1997.

Radio Shack conducted a trial of PageMart's products and services with 600 company-owned stores during 1996 in Hawaii and California prior to awarding the nationwide account.

Anritsu Wiltron opens its first North American facility

Anritsu Wiltron, Morgan Hill, CA, opened its first North American manufacturing facility, part of its global strategy to better serve its customers. The facility is located in Morgan Hill.

The new production facility will initially produce Anritsu's MT8801B radio communication analyzer, originally designed and engineered in Japan. Additional products will be added in the future, as demand warrants. The instruments, part of the Anritsu Manufacturing Division (AMD) product line, will be brand-labeled Anritsu and shipped from Morgan Hill to customers in the United States and to international customers.

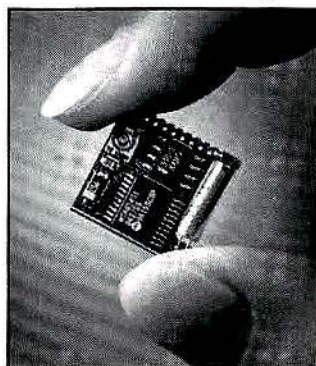
Located next to the Wiltron Telecom Division's manufacturing facilities, AMD will use manufacturing and assembly capabilities that have already been employed.

Digital ANI. Their number's up.



ID-700

Caller ID



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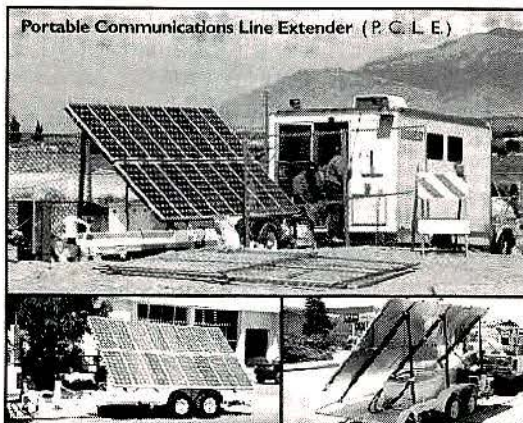
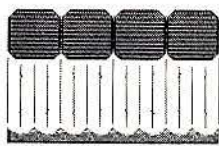
Caller ID will end the stuck mikes and stop the horseplay. ID-3300 has ID, time-out timer, and emergency. Fits inside smallest portable. Fleet price \$75 ea. 800-521-2203.

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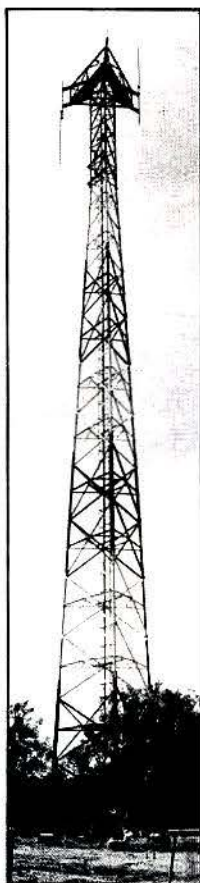
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Circle (36) on Fast Fact Card

News

E.F. Johnson, Motorola pursue Twin Cities public-safety radio contract

E.F. Johnson, Burnsville, MN, and Motorola's Land Mobile Products Sector, Schaumburg, IL, are teaming up to propose building a new region-wide, digital trunked 800MHz public-safety radio system for the Twin Cities metro area. The proposal will be submitted to the state of Minnesota by Aug. 4, 1997.

The Metropolitan Radio Board, formed by the Metropolitan Council and made up of public-safety communications professionals and representatives from local government, has been working since 1991 to analyze needs and develop specifications for a new radio communications system. The current two-way radio systems, many of which are more than 20 years old, are incompatible and do not have enough capacity to handle the enormous volume of communications among various public-safety individuals and departments.

The first phase of the anticipated statewide system will cover nine counties. This phase will include Hennepin county, the city of Minneapolis and Minnesota state agencies located within this area. One of the key benefits of the new system will be that public safety and government employees in different counties, cities, departments and agencies will be able to better communicate with each other, especially during emergencies.

In October 1994, E.F. Johnson and Motorola signed a joint licensing agreement to promote compatibility of digital radio communications systems. Both companies can use common digital technology to develop future products that would be interoperable.

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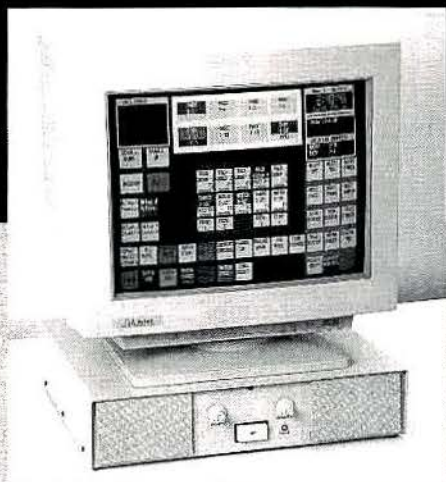
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Circle (40) on Fast Fact Card

News

Columbia Spectrum Management acquired by P-Com

Columbia Spectrum Management (CSM), Vienna, VA, is expanding its services to include program management for new network build-out on the national and international levels. The announcement came in the wake of the acquisition of CSM by P-Com, Campbell, CA, in March.

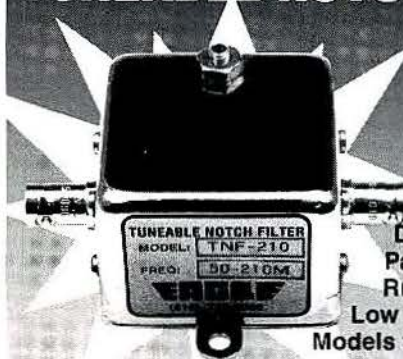
Since its founding in 1994, CSM has specialized in complete, turnkey microwave relocation and has served some of the nation's PCS providers.

The company plans to provide a comprehensive line of program management services to wireless telecommunications companies building microwave, PCS, local loop, cellular and other wireless networks. These services include systems and program planning, engineering, equipment installation, testing and training, among others. CSM will also be responsible for turnkey program management services for P-Com customers worldwide.

Glenayre establishes \$25,000 scholarship, endowment

Glenayre Technologies, Charlotte, NC, has established a \$25,000 scholarship endowment at Virginia Polytechnic Institute and State University, Blacksburg, VA. The scholarship provides \$5,000 annually toward the tuition and related expenses for a period of five years to a student majoring in communications engineering. It is presented to foster technical expertise in the personal communications field. The Personal Communications Industry Association (PCIA) will administer the scholarship. Glenayre's board of directors is also creating a 5-year endowment in which each board member personally contributes a minimum of \$2,000 to the PCIA foundation.

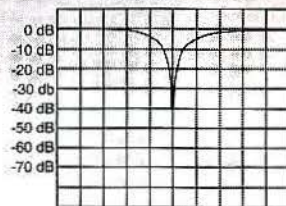
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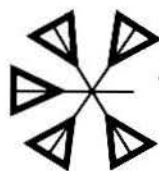
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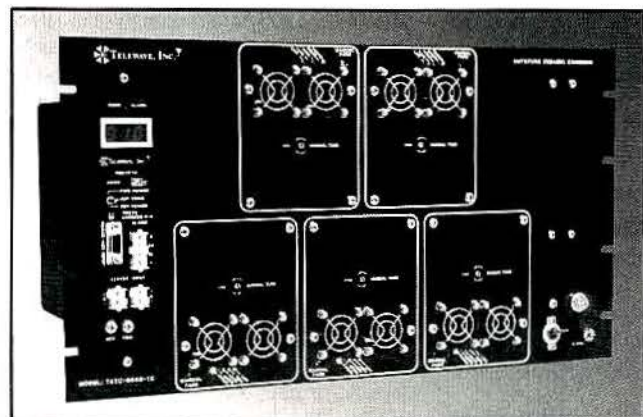


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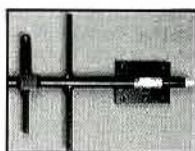
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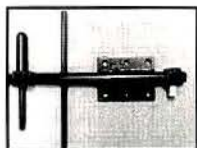
ANTPD21

Telewave Yagi Antennas now cover 138-2000 MHz and feature 3 different cable attachment and mounting options, as well as fully welded construction and exclusive TXYLAN™ coating.

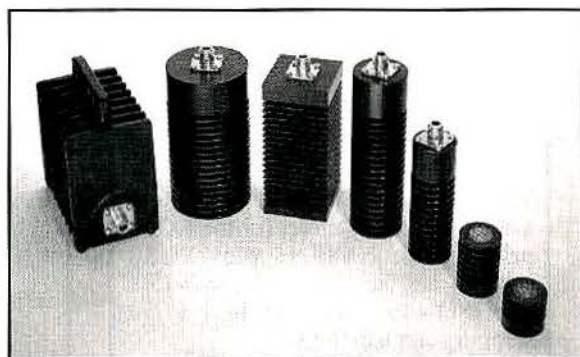
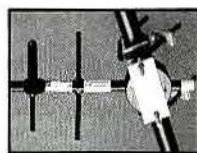
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Circle (43) on Fast Fact Card

News

Americall International awards AirNet \$40-million equipment contract

AirNet Communications, Melbourne, FL, has signed a purchase agreement for as much as \$40 million to supply personal communications services (PCS) wireless infrastructure equipment and services to Americall International, Phoenix. Americall International successfully bid in the FCC's PCS C-block and F-block auctions. The company announced that AirNet will be its sole provider of network infrastructure equipment.

Americall International has obtained the license to provide PCS service in 14 basic trading areas (BTAs) in five states including Alaska, Ohio, Oregon, Texas and West Vir-

ginia. The 14 BTAs have a population of 3.6 million. The system deployment will start in the third quarter of 1997 in the Corpus Christi and Laredo, TX, BTAs.

Under the terms of the agreement, consisting of a two-phased deployment plan, AirNet will supply and install a global system for mobile communications (GSM)-based PCS-1900 base station system (BSS). The system will include the ARE (AirNet range extender) products, which extend the coverage of a single AirNet broadband transceiver systems (BTS) as much as 1,100 square miles.

Trident and Standard agree to technology alliance

Standard Communications, Torrance, CA, and Trident Micro Systems, Huntington Beach, CA, have formally agreed to jointly develop and market products supporting Trident's PassPort NTS trunking protocol.

The PassPort NTS enhanced trunking protocol provides SMR system operators with wide-area Smart Dispatch networking, more than 60,000 unique ID codes

per site, voice mail, automatic registration and de-registration of roaming mobiles, over-the-air programming and other advanced features. The PassPort NTS infrastructure is an all-digital platform. Capable of supporting LTR and PassPort mobiles, the PassPort NTS system provides a ready migration path from current and next-generation analog radios to complete digital networks.



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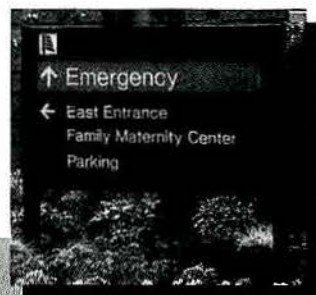
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Digital Tone Remote



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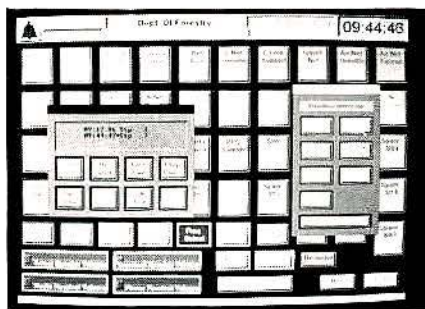
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Circle (57) on Fast Fact Card

New products

Readers' choice

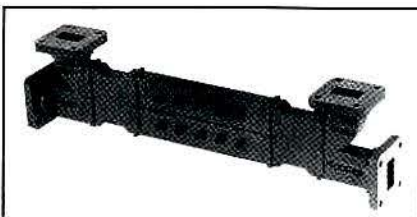
Of all the new products and services in the October 1996 issue, the one reprinted here generated the most reader requests for additional information. If you missed it the first time, here is your opportunity to acquire more information on it. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

The Auxiliary Power System series of standby generators from Generac includes utility voltage monitoring, automatic start-stop, engine safety shut-downs and system battery charging. Options consist of ac or dc voltage outputs, telemetry monitoring, automatic transfer switch and weather-protected outdoor enclosures. Rated from 3kW to 8kW, the generators are available in natural gas or LP-fueled models. The three largest models have a 25" x 19" footprint.



Circle (500) on Fast Fact Card

Diplexer combines Ku band uplink and downlink



The model 9169 diplexer from Microwave Filter is used to combine the Ku band uplink (14.0GHz-14.5GHz) and downlink (11.7GHz-12.2GHz) to eliminate additional

WR-75 waveguide runs. Insertion loss is 0.5dB maximum and VSWR is 1.25:1 maximum. Rejection is 50dB minimum for the downlink band and 35dB minimum for the uplink band. Power handling is 1W for the downlink and 500W for the uplink. Construction is WR-75 with cover flanges at all ports. This unit can also be supplied in invar waveguide for temperature stability when the operating environment includes wide temperature swings. The dimensions are 10.5" x 2.635".

Circle (401) on Fast Fact Card

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Circle (58) on Fast Fact Card

Murphy's Law #486



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there will
always
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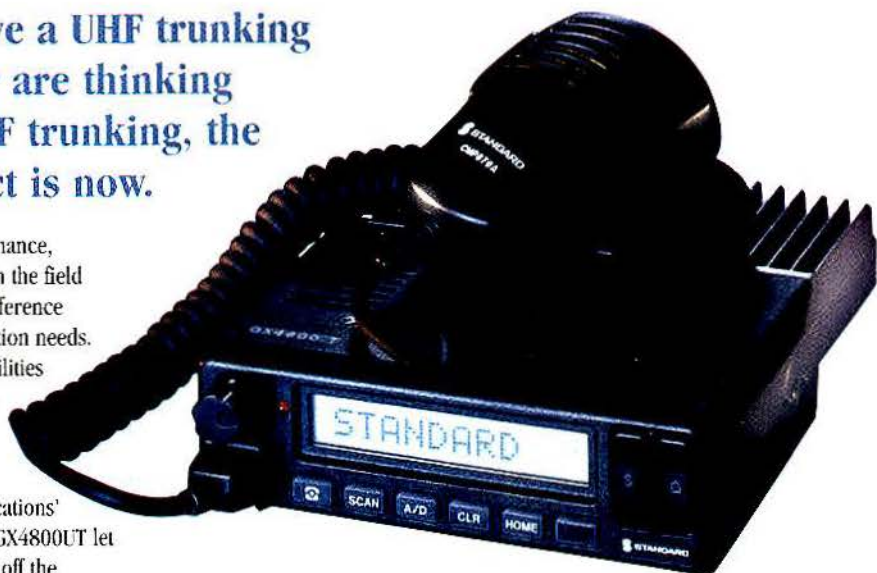
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Circle (70) on Fast Fact Card

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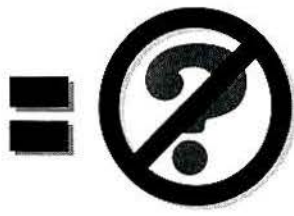
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Circle (60) on Fast Fact Card



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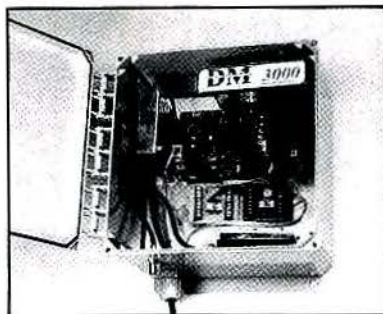
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Circle (61) on Fast Fact Card

New products

Data collection, control system operates in two modes

Control Technology's (CTI) Data Messenger (DM) provides a full line of data collection and control cards. The DM is available with a 3- or 7-slot motherboard. A total of 32 motherboards as far as 4,000 feet apart can be connected together using the DM's RS485 two-



wire communication buss, a "hub and spoke" approach. These units will then share a common communication device to the host unit. This structure equates to 1,780 inputs and outputs per site. The maximum number of sites per system is 250. Communication interfaces include telco, telemetry, four-wire and RS-232. The product incorporates flash memory to store its information. This flash memory is addressable through the system's communication link. The DM is suitable for small applications as well as large SCADA operations. It operates in a polled mode, report-on-exception mode, or a combination of both. It may be used for transfer of information and/or control from one unit to another; it can be connected to a computer display, or operated entirely within itself for real-time control. The DM units can communicate between themselves to relay information from a site that isn't within range of a host.

Circle (402) on Fast Fact Card

Transceiver serves SCADA applications

Johnson Data Telemetry's latest addition to its synthesized radio product line is the 900MHz DL-3492. This 5W transceiver covering 928MHz-960MHz is designed for SCADA applications. The DL-3492 offers eight-channel operation and is customer PC-programmable, permitting complete radio configuration to meet system requirements. It provides two power minimization features: a sleep mode that draws no more than 8mA (operational in 13ms) and an inherent cold start so the unit will reach an operational state in less than 30ms, allowing the user to cycle power on and off. When paired with the DL-3276 modem, the DL-3492 provides real-time diagnostic information locally and over-the-air. System information such as forward/reflected power, RSSI, temperature, current sense, input voltage sense, modulation flatness and power set is available for troubleshooting and maintenance.

Circle (403) on Fast Fact Card

Three-sector antenna mounts inconspicuously

COMSAT RSI Wireless Antennas' Aerodynamic Unicell, a member of the Unicell family, is a high-gain, three-sector, diversity antenna in a housing that can be inconspicuously mounted on a monopole, rooftop or other highly visible sites. The Unicell comprises three separate antennas that are housed together in an aesthetically pleasing unit. The unit allows maintenance by providing access to any one of the three sections of the antennas without disturbing the operation of the three sections.

Circle (404) on Fast Fact Card

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New products

ATI adds DS3/E3 data capacities to digital microwave radio systems

Advanced TechCom (ATI) has added DS3/E3 data capacities to its FSK+ digital microwave radio systems line. The radio systems are available in non-protected and protected system configurations covering frequency bands from 1.5GHz to 23GHz. Frequency diversity and hot standby-protected systems provide fully redundant transmitter and receiver components, power supplies and cables. The 1+1 error-less receiver switching protects against at-

mospheric fading and equipment failures. The digital interface unit (DIU) and radio frequency unit can be located as far as 1,500ft (450m) apart. Other features include a broad range of data rates, 4-FSK modulation, a PC-based menu, a front- and rear-accessible DIU, automatic electronic DADEing, user-configurable data scrambler and descrambler and built-in diagnostics and testing.

Circle (405) on Fast Fact Card

ISDN multiplexers extend network reach and efficiency




IntraLink multiplexers from Intraplex allow mobile radio operators to use ISDN digital circuits to extend the reach and efficiency of their networks. IntraLink is available in a variety of configurations and supports interchangeable plug-in modules for various applications. The product also offers automatic redial if a network interruption occurs, call screening for enhanced security, PC-based remote or local configuration, diagnostics and performance monitoring, local and remote loopback, ability to route 64kb/s B channels independently to separate locations and integrated ISDN terminal adapter for simplified installation and built-in interfaces for universal network compatibility.

Circle (406) on Fast Fact Card

Digital receiver operates in VHF or UHF band

RF Neulink's DCL-VHF-DX is a synthesized, digital receiver operating in the VHF band, 153MHz-173MHz. The band spread is 10MHz in the 153MHz to 173MHz, and the receiver can be tuned to any frequency in the selected band. The receiver is 3.5" x 7.5" x 10"; the antenna port is a female BNC. The receiver is also available in the 450MHz-470MHz UHF frequency band.

Circle (418) on Fast Fact Card



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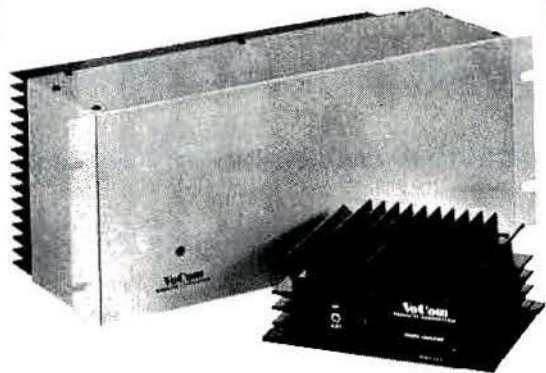


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Circle (67) on Fast Fact Card

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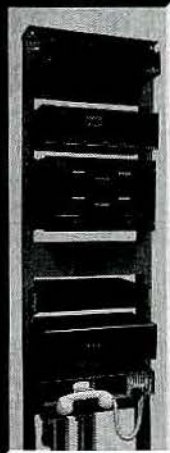
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Circle (66) on Fast Fact Card

New products

NPCS modem allows wireless meter reading,
control of appliances and equipment



A two-way paging technology that will enable utility companies to offer a variety of new services in the age of deregulation has been developed by the Messaging Derivatives Division of Motorola's Advanced Messaging Group. Using Reflex protocol-based, two-way paging, utility companies can now use a low-cost, nationwide wireless network for automated

meter reading and other utility automation applications. The device, the Reflex narrowband PCS modem, uses two-way paging to read meters during low-volume hours. It can also be used to facilitate demand-side management operations, such as controlling appliances in houses and equipment in businesses to prevent brownouts. The Reflex protocol is a part of Motorola's Flex family of paging protocols.

Circle (407) on Fast Fact Card

Caller ID system provides E9-1-1-like information
from seven-digit lines regardless of call center

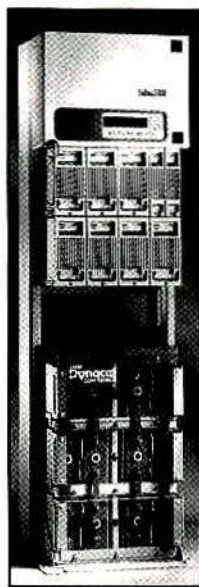
The model 970 caller ID system from Zetron's Public Safety Division enhances new and existing PSAP and dispatch telephone systems. The unit decodes and presents for display the caller ID information provided with seven-digit telephone calls, including those used for emergency numbers. Depending on the message



format used by the telephone company, caller ID information can include time and date of call, telephone number of the caller, and the name associated with that telephone number. Regardless of whether a call center is equipped with E9-1-1, basic 9-1-1 or no 9-1-1 at all, the model 970 can be easily incorporated into most 1A2 telephone systems to provide E9-1-1-like information from seven-digit lines. The unit is fully CAD-compatible.

Circle (408) on Fast Fact Card

Dc power system provides total front access



The Horizon modular series of compact, lightweight and rugged dc power systems from **Yuasa-Exide Energy Products Group** provide total front access for simple installation and maintenance. The systems incorporate 1A-100A plug-in breakers that can be changed or added to correspond with new load conditions or equipment conversions. The systems feature true "hot pluggable" insertion of Yuasa-Exide's Vector series rectifier and dc-to-dc converter modules into an intelligent backplane that connects to the controller or monitor. All system and component level settings, as well as load sharing, are managed from the controller so users do not have to make subsequent component-level adjustments after initial setup. "Hot" buttons and "soft" keys permit instant, on-site monitoring of all system and module parameters. An RS232 port and a built-in modem allow users to vi-

sually review conditions from any location having a phone line and access to a PC.

Circle (409) on Fast Fact Card

Under-dash mobile radios offer 20-channel wideband coverage; feature streamlined front panel

Syn-Tech Bantam multi-mode, FM, two-way, under-dash mobile radios from **Midland USA** offer 20-channel wideband coverage with a choice of 136MHz-174MHz VHF or 450MHz-470MHz UHF to meet business and industrial applications.



The small design makes the radio, measuring 1 7/16" x 6 5/16" x 3 15/16", suitable for under-dash installations, even in subcompacts. The streamlined front panel is fully functional without the safety risks of sharp protruding knobs and buttons. The radios include built-in programmable CTCSS, DCS and CS; programmable channel spacing of 12.5kHz, 25kHz and 30kHz; channel stepping of 5kHz and 6.25kHz; a programmable time-out timer; fast-priority scanning at a rate of 40 channels per second; and rugged construction to MIL 810 C/D/E shock and vibration specifications.

Circle (410) on Fast Fact Card

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New products

Portable RTU monitors natural gas distribution systems

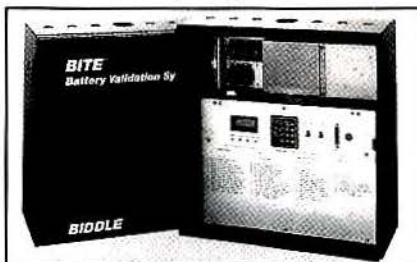
Telescad's ATS-8 Pitmonitor is a small RTU designed for real-time monitoring of natural gas distribution systems. The ATS-8C, the latest product in the ATS-8 Pitmonitor line, provides total portability. The unit requires no ac power. The RTU supports analog inputs, status and alarm inputs and historical data collection, packaged in a NEMA 4/12 enclosure for above-ground installations. A solar battery charger is supplied as standard equipment, making this unit suitable for any application requiring remote monitoring and data logging where ac power and communications are not readily available. Some typical applications are distribution, transmission and environmental monitoring for electric, gas, landfills, oil, water and wastewater. This product provides real-time data log-



ging of system variables and alarms while monitoring local status for exception reporting to the master station.

Circle (411) on Fast Fact Card

On-line battery impedance monitoring system measures cells, voltage



AVO International's Biddle BITE battery validation system (BVS), an on-line monitor, is for use in the power utility industry. The BITE BVS monitors as many as 60 cells (96 for NiCd applications) for internal cell impedance and

connection resistance. It also measures battery voltage, cell voltage and ambient and pilot cell temperatures. The BVS features automatic test and data acquisition with programmable intervals of 1 to 99 days between test cycles, and 1 to 30 minutes during power outages. The system employs an internal NiCd battery for loss of power conditions. Alarms alert users to out-of-limit conditions of cell impedance and voltage, as well as system voltage, loss of ac power and temperature. Such alarms can be verified with equipment from the BITE family of test instruments.

Circle (412) on Fast Fact Card

Pager operates 15 weeks on battery

Philips Consumer Communications' Jacana is a front-display numeric pager that operates as long as 15 weeks on a single AAA battery. Jacana is colorful, small (2"), light (1.5 ounces) and easy to carry in a pocket, a bag or a holster. Holsters are available in a range of colors. Because there is room for 24 messages of 20 digits each, the user can store calls. Two buttons and a clear, backlit display make Jacana easy to use in low-light conditions. The pager also features a choice of four musical alert tones, silent vibration alert and clock with alarm function.

Circle (413) on Fast Fact Card

Panel antennas provides null fill and side lobe suppression

Sinclair Technologies' series of panel antennas are designed for PCS and PCN applications in the 1.850MHz-1.990MHz and 1.710MHz-1.880MHz frequency ranges. The SP-50 series panel antennas offer gains of 16dBi-17dBi with radiation patterns engineered to provide null fill and side lobe suppression. Sinclair uses microstrip technology and precise manufacturing processes to achieve consistency from antenna to antenna, simplifying system implementation while allowing for accurate maintenance of phasing in large arrays. The lack of metal rivets in the antennas' construction yields a low intermod level of -155dBc (maximum). When tested with two 20W sources, the measured level of third- and fifth-order harmonics surpassed the specified -155dBc.

Circle (414) on Fast Fact Card

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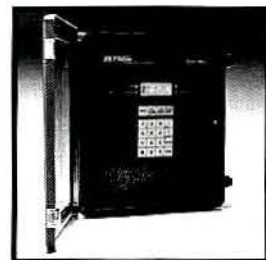
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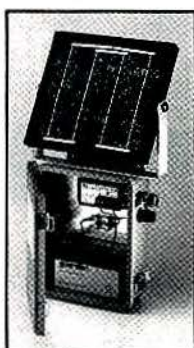
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Circle (46) on Fast Fact Card

Solar electric generators provide reliable power

SunMate solar electric generators (SEGs) from Atlantic Solar are rugged, self-contained power systems that provide continuous, reliable power in areas where conventional electricity is non-existent or unreliable. Typical applications are microwave repeaters, cellular phones, radio transmitters, fiber optics, cell enhancers and battery maintenance. Each SunMate provides steady, clean power with sufficient storage capacity to continuously operate during extended periods of inclement weather. SunMate SEGs can be mounted on poles, towers, trailers, rails or on the ground, and are available in either ac or dc configurations. Custom systems are available. All standard components are UL-listed. The SunMate features the optional desulfator battery conditioning circuit, which extends battery life.



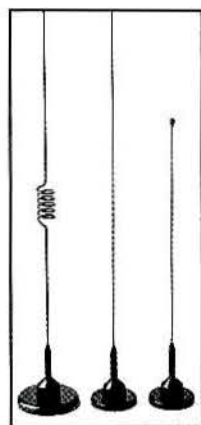
Circle (415) on Fast Fact Card

Portable computer withstands elements in GPS/GIS field inventory; features long battery life

OmniData International's RDT 3200 is a rugged, portable computer for GPS and GIS field inventory data collection. Featuring a water-sealed enclosure that meets NEMA-4 requirements, drop specifications of five feet and a temperature tolerance of -4°F to 122°F (-20°C to 50°C), the RDT is also a fully functional PC with a full-size QWERTY keyboard. The battery life of the RDT 3200 is 12 hours, allowing personnel to work a full day on a single charge. The RST 3200 carrying harness maintains adaptability and comfort in the field while permitting hands-free operation.

Circle (416) on Fast Fact Card

Antennas provide as much as 54# pull strength



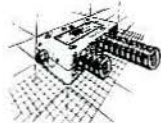
Larsen Electronics' "mini mags" are small magnetic-mount antennas that are pretuned in VHF and UHF frequencies, in unity and 3dB (UHF only) configurations. Each is constructed using extra strength magnets, coax and Larsen's black Kulrod, copper-plated 17-7 stainless-steel whips. The cable is terminated with the FME universal adapter, which allows for a variety of connector options, including SMA male and female. The MS is a 2" magnetic mount in a quarterwave design, offering unity gain options for VHF and UHF frequencies. It provides 18 pounds of pull strength and uses RG-174 stranded coax. No tuning is required. The MM is offered in UHF frequencies (406MHz-512MHz) with 3dB gain. This 3" magnetic mount has 54 pounds of pull strength and uses RG 58 A/U coax. These models are tunable to provide the best performance at the exact frequency required.

Circle (417) on Fast Fact Card

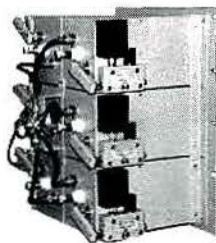


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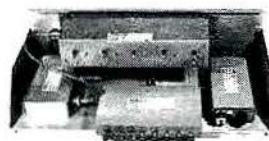
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Circle (48) on Fast Fact Card

TRANSMITTER LOCATION



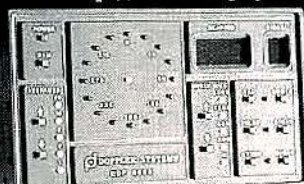
New fixed site direction finders provide 2 degree accuracy, and include software for triangulation from a central control site. Mobile versions also available covering 50MHz to 1 GHz



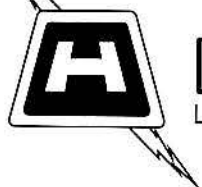
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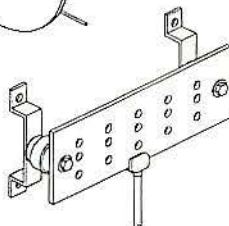
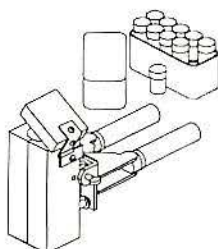
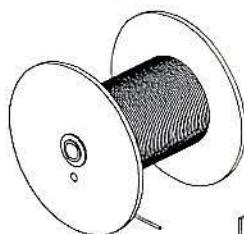


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P people



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Eduardo Zaldivar departs E.F. Johnson, Burnsville, MN, as manager of international sales and marketing and joins Kenwood Communications, Long Beach, CA, as international sales manager.

Changes at Trilogy Communications, Jackson, MS:

R. Jeff Morris leaves AT&T, where he held director-level positions with its international and outside plant systems divisions, and joins Trilogy as vice president of international operations for the CATV, cellular and SMR markets.

N. Preston Stone departs as director of marketing, Asia-Pacific for Datotek, Dallas, to join Trilogy as head of the new network products division.

Senator John McCain, (R-AZ), Chairman of the Committee on Science and Transportation is honored with the Lifetime Achievement Award from the Personal Communications Industry Association (PCIA).

Stephen R. Cook leaves GTE MobilNet's Mid-South region, Atlanta, as president and joins Conxus Communications, Greenville, SC, as chief operating officer.

Promotions at LeBlanc, Richardson, TX:

Dennis Harward, director of sales, advances to vice president of sales.

Larry Penner moves up to vice president of corporate administration but will continue to be responsible for the field policy and the field safety program.

Richard Heisler, regional manager of LeBlanc's central branch group, becomes vice president of field operations for the company's structures division.

Changes at E.F. Johnson, Burnsville, MN:

Mark Allen advances to vice president of E.F. Johnson Services, a separate business unit for wireless construction services. He retains his position as vice president of engineering at E.F. Johnson.

Steve Katkov continues as the unit's construction manager.

Patrick Murtha departs as senior vice president, corporate development, Telular, Buffalo Grove, IL, to join Mobile Systems International, Dallas, as vice president of business development.

Changes at the Electronic Industries Association (EIA), Arlington, VA:

John Major, senior vice president, Motorola, Schaumburg, IL, is elected to co-vice-chair, to serve along with the current vice-chair, **Gil Amelio**, chairman of Apple Computer.

Sherel D. Horsley, senior vice president of Digital Printing Systems, Texas Instruments, Austin, TX, is elected treasurer.



TIA publishes two interim standards, bulletin on land mobile services

The Telecommunications Industry Association (TIA) has published two new interim standards and the systems bulletin that provide technical information regarding emerging digital technologies for the land mobile services. Specifically addressed is the Associated Public-Safety Communications Officers International (APCO) Project 25. TIA/EIA/IS-102.BAAA describes the access method, bandwidth, modulation, data rate and message format for radios meeting the Project 25 requirements. TIA/EIA/IS-102.BABC describes a digital voice coder

(vocoder) reference test for codes meeting The evaluation procedures to be employed by TIA in its assessment of various digital voice coding technology proposals for Project 25 are described in TIA/EIA/TSB-102.BABD. The documents were published in accordance with terms and conditions provided for in a Memorandum of Understanding executed by and between TIA, APCO, the National Association of State Telecommunications Directors and various agencies of the federal government.

Circle (451) on Fast Fact Card

Catalog highlights test-system components, configurations

Hewlett Packard's 1997 *Test System and VXI Products Catalog* contains a complete selection of test-system components, VXI products and services. The free catalog provides test engineers with ways to identify and select system components and to create compatible configurations. The catalog is an overview document designed for identification of and access to system components. The color, 176-page catalog includes concise product descriptions and is immediately available on the accompanying CD-ROM.

Circle (452) on Fast Fact Card

Telecom dictionary gives official legal and regulatory definitions

In one volume, the *Official Telecommunications Dictionary from Government Institutes* includes the official U.S. government definitions for more than 15,000 terms, abbreviations and acronyms—compiled directly from the Telecommunications Act of 1996, the Communications Act of 1934 As Amended and the Code of Federal Regulations. The dictionary includes the citation of the source document for each definition, as well as a comprehensive listing of acronyms. The dictionary provides multiple definitions for terms.

Circle (453) on Fast Fact Card

Brochure describes system power protection for sensitive electronic loads

Liebert series 300 uninterruptible power supplies for sensitive electronic loads are featured in a 12-page, color brochure. The features and benefits highlighted are on-line power protection; additional options to meet various applications; fail-safe control and monitoring; and optional communications features. An overview outlines a computer's power needs, including computer-grade power, complete load handling, continuous op-

eration and bypass operation. Then the brochure details standard, stand-out features of the Series 300 UPS. For example, the UPS does not require back access, which means it can be placed against a wall for best use of computer room floor space. The UPS also offers field-selectable input voltage, which means most models can operate from either 208V or 480V input power.

Circle (454) on Fast Fact Card

Buyers' Guide includes 262 manufacturers, 17,000 products

Tessco's first-edition 1997 *Buyer's Guide* consolidates the offerings of 262 manufacturers, giving full side-by-side descriptions, pricing and delivery information for more than 17,000 products. Tabbed sections cover infrastructure, mobile and portable, and shop, bench and test equipment products. The book has a color-coded indexing system, color product sheets and product pages. Also available is Tessco Magic 2.2 purchasing software, the complete Tessco Buyers' Guide on diskette or CD ROM.

Circle (455) on Fast Fact Card

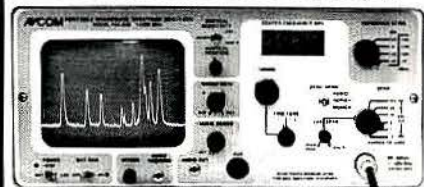
Catalog features coaxial connectors and assembly tools

The Huber+Suhner 470-page coaxial connectors catalog contains photographs, outline drawings, performance specifications and environmental data. Also included are assembly tools, engineering and application notes addressing passive intermodulation (PIM) and various other topics, glossary and appendices. The line of coaxial connectors includes dc to 40GHz. Coaxial connectors are available from 7/16 DIN to microminiature surface mount MMCX.

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Mobile Radio Technology

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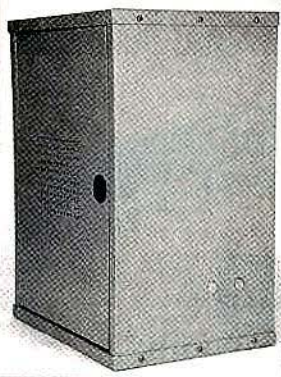
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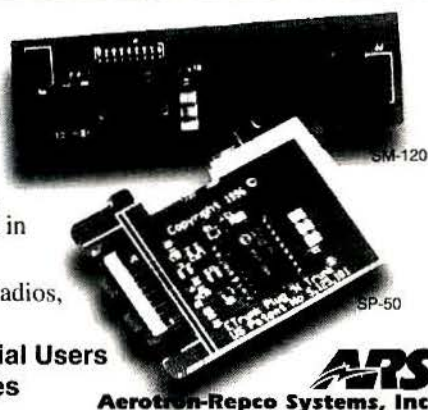
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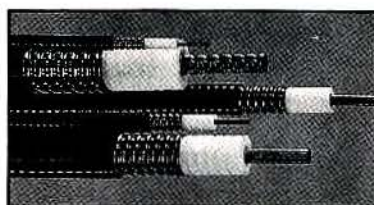
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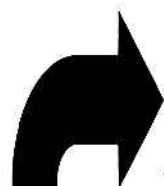
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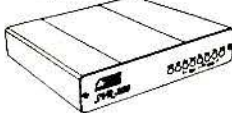
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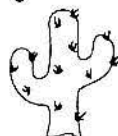


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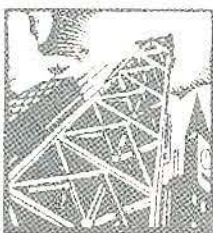
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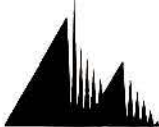
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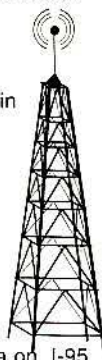
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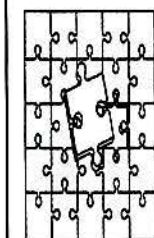


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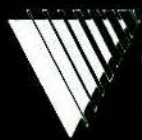
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Circle (2) on Fast Fact Card



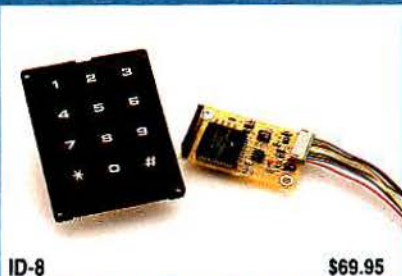
TP-3200 \$279.95

Full Featured Shared Repeater Tone Panel with ALL 157 CTCSS/DCS codes. In Desktop or Rack Mount version.



CSI-100 \$749.95

Video Modem. Sends and receives broadcast quality, single frame, color video over ANY narrow-band communications channel.



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Automatic Morse Station Identifier. Meets all FCC ID Requirements. Fully field programmable with included keypad. 1.85" x 1.12" x .35"



TE-64 \$79.95

Self-contained Encoder, Rotary Dial Selection. Great for the Benchtop. 5.25" x 3.3" x 1.7"



CC-1/CR-1 \$49.95 each

Surface Mount Component Kits for repairing SMT circuits. CC-1 for capacitors/CR-1 for resistors.



PE-1000 \$224.95

Desktop Paging Encoder. Two-tone sequential, other formats available. 7.5" x 7.8" x 2.7"



PE-2P \$54.95

Two-tone Sequential Encoder. Sub-assembly mounts inside radio or other enclosure. Multiple call capability. 1.25" x 2.0" x .4"



SD-1000 \$59.95

Two-tone Sequential Decoder. Programmable unit provides switched outputs from two-tone paging calls. 1.25" x 2.0" x .4"



DTD-1 \$49.95

Single Function DTMF Decoder. Provides switch outputs via DTMF. 1.25" x 2.0" x .4"



PE-4/PE-15 \$79.95

Multiple Call POCSAG (RPC-1) Paging Encoders. Where direct control of local area paging is desired. 1.78" x 1.03" x .35"



DCS-23 \$59.95

Digital Coded Squelch Encoder-Decoder. Programmable to all codes. 1.36" x 1.18" x .25"



TS-32P \$57.95

Programmable CTCSS Encoder-Decoder. Tone squelch for any FM transceiver. 1.25" x 2.0" x .4"



TS-64 \$54.95

Sub-miniature Programmable CTCSS Encoder-Decoder. 1.7" x .78" x .25"



SS-32SMP \$27.95

Sub-miniature CTCSS Encoder. Jumper programmable. .53" x 1.0" x .16"



SS-32PA \$28.95

Programmable CTCSS Encoder. Custom tones or audible tones also available. .9" x 1.3" x .4"

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